THE RELATIONSHIP BETWEEN BANK CONCENTRATION AND THE INTEREST RATE PASS THROUGH IN SELECTED AFRICAN COUNTRIES

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DECLARATION

Except where explicitly stated otherwise and acknowledged, this thesis is wholly my own work and has not been submitted to any other University, Technikon or College for degree purposes.

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ABSTRACT

Given the importance of monetary policy in the operation of a successful modern economy and the use of official[2] interest rates as tools in its implementation, this study investigates the implications of changing bank concentration on the operation of the Interest Rate Pass Through (IRPT) of official rates to bank lending and deposit rates. This is an issue made more poignant by growing mergers, acquisitions and bank consolidation exercises around the world that have brought interest to their implications for economic performance. However, with contention high in the industrial organisation theory on the likely relationship between bank concentration and the IRPT, and the outcomes of empirical investigations producing conflicting evidence, the desire to investigate the issue in the African context necessitated a thorough empirical investigation of four African countries (South Africa, Botswana, Nigeria and Zambia).

This study not only extended the investigation of the issue to the African context, but it merged different IRPT measurement techniques that had not been jointly applied to this particular issue, namely; Symmetric and Asymmetric Error Correction Models, Mean Adjustment Lags, Ordinary Least Squares estimations and Autoregressive Distributed Lag models. These measures of the IRPT were compared with three firm concentration ratios on two different levels of analysis, one, over the entire period and, another, through eight year rolling windows.

The results reveal that bank concentration can sometimes be related to the speed and magnitude of the IRPT but that these relationships are not consistent amongst the countries, over the entire sample period or across the two levels of analysis, suggesting reasons why empirical results have arrived at contrasting conclusions. The results revealed more evidence of a relationship between bank concentration and the magnitude of the IRPT than between bank concentration and the speed of the IRPT. Furthermore, where relationships were identified there was evidence supporting both the structure conduct performance hypothesis and the competing efficient market hypothesis as the true representation of the relationship between bank concentration and the IRPT. The key implication of the result for African countries is that increased bank concentration through bank consolidation programmes should not be automatically regarded as detrimental to the effective implementation of monetary policy through the IRPT. Consequently,

[2] The word "official" will be used interchangeably with the word "policy" when describing the interest rates set by monetary policy authorities.

banking sector regulation need not stifle bank consolidation and growth to preserve monetary policy effectiveness. Rather, since the relationship cannot be neatly represented by a single theory or hypothesis each country must determine its own interaction between bank concentration and its IRPT before policies regarding the banking sector concentration and effective monetary policy, through the use of official interest rates, are determined.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND, CONTEXT AND RATIONALE FOR THE RESEARCH

While there has generally been consensus on the importance of effective monetary policy, debate on the most appropriate means to achieve it has created long standing issues in the literature of Monetary Economics and Central Banking (Rasche and Williams, 2005). According to Mishkin (1995), monetary policy is only effective if its tools are able to quickly transmit monetary impulses to interest rates and if the resultant new structure of interest rates affects real expenditure. This understanding of monetary policy implementation divides the operation of monetary policy into two stages. The first is the transmission of the desired monetary policy impulses to interest rates and the second is the translation of those impulses into changes in real expenditure. It is this important first stage of interest rate transmission from policy dictated rates to interbank and retail rates that is known as the interest rate pass through (IRPT). As a key conduit for monetary policy that relays the policy stance to the economy, the IRPT makes official interest rates effective by allowing them to be reflected in bank lending and deposit rates[3].

The task for monetary authorities and the focus of wide research has been on understanding the IRPT and ensuring that it remains strong[4]. Failing this, policy rates are weakened as effective tools for monetary policy. With this in mind, effective monetary policy analysis has now not only concerned itself with measuring the IRPT but with determining the catalysts for and impediments to a smooth IRPT.

It is at the point of impediments that early work by Hannan and Berger (1991), Neumark and Sharpe (1992), and Cottarelli and Kourellis (1994) suggested a look at bank market structure to explain differences in the IRPT amongst banks within a country and comparatively between banks in different countries. By merging industrial organisation theory and the IRPT they

[3] This IRPT is effectively the crucial first step of Mishkin's (1995) Monetary Transmission Mechanism.
[4] A strong/smooth IRPT refers to a pass through process in which official rates are fully and quickly reflected in bank lending and deposit rates. This makes IRPT analysis synonymous with the measurement of its speed and magnitude.

suggested the analysis of the banking industry as a key determinant in the effectiveness of monetary policy because of the role it could play in the strength of the IRPT.

Amongst the characteristics of the bank market structure that they investigated was the impact of bank concentration. Bank concentration is particularly interesting because different industrial organisation theories, and the interpretation of those theories, provide ambiguous implications for the relationship between changing bank concentration and the conduct of banks and, ultimately, the IRPT.

Bain's (1956 in Hannan and Berger, 1991) structure-conduct-performance hypothesis suggests a clear positive relationship between market concentration and a weak IRPT based on the expected behaviour of market participants in highly concentrated markets. This is because highly concentrated markets provide opportunities for collusive behaviour that allows banks to carry lending and deposit rates that do not necessarily reflect the desired stance of monetary policy authorities. In contrast, the efficient structure hypothesis suggests that the IRPT would strengthen as the market became concentrated and the inefficient banks were removed from the market. This would be the case where banks that may have tried to artificially maintain bank rates that did not reflect prevailing official rates were forced out of the market. Empirically, in the work of Hannan and Berger (1991), Neumark and Sharpe (1992) and Scholnick (1996) banking sector concentration influences bank conduct and consequently the nature of the IRPT. Conversely, in the studies conducted by Cottarelli and Kourellis (1994), Berstein and Fuentes (2003) and Abbasoglu *et al*. (2005) banking sector concentration does not influence the IRPT. As evidenced by this, not only was the theory not in agreement but its disparities were confounded by conflicts in the evidence from empirical research.

Understanding whether or not bank industry concentration is related to a weak or strong IRPT is important because it will inform banking sector competition regulation. If concentration impedes the IRPT, and consequently effective monetary policy, then it is of paramount importance that the banking industry should be regulated to increase the number of market participants and reduce concentration. If concentration improves the IRPT then banking regulators may need to consider the possibility of consolidating their banking industries to encourage more

concentration to enhance the effectiveness of monetary policy[5]. In addition to informing regulation of the banking industry, identifying a relationship has implications for the setting of monetary policy when bank concentration is changing. To illustrate, should bank concentration be related to a slower IRPT then the timing of official rate changes must change to ensure that they are set early enough to have the desired effect at the desired time. If, on the other hand, bank concentration is related to the a weakening of the magnitude of the IRPT then policy changes must be large enough to cater for the diminished reflection of official rates in bank lending and deposit rates. However, such ambiguity alone would not necessarily merit research if important reasons did not exist in favour and against concentrated banking industries.

In the banking sector, unlike other sectors of the economy, competition policy must take note of the interaction between the structure of the banking industry and financial stability. According to Allen and Gale (2003), highly concentrated banking markets are better suited to withstand financial crises than less concentrated banking markets. This is a view that is supported by Beck *et al*. (2003) who suggest that banking systems characterised by a few large banks are better suited to diversify their products and thus lower bank fragility in the event of a crisis. In addition, the high profits that banks in such highly concentrated industries make insulate them from adverse shocks to the economy while reducing the incentives for their owners to take excessive risk. Soludo (2004) adds further support for highly concentrated banking industries by highlighting that banking service proliferation is likely to be higher in more concentrated markets with a few large banks (with the capital and economies of scale to finance expansion) rather than less concentrated markets with many small banks (without capital to finance expansion)[6]. Furthermore, the problems of asymmetric information that may result in the rationing of credit, to the detriment of economic growth, are reduced by large banks with the ability to engage in relationship banking and dedicate large amounts of resources to collecting information on potential borrowers (Allen and Gale, 2003).

[5] It is important to note that the results on whether high or low bank concentration is related to a weakening or strengthening IRPT can only partially inform banking sector competition regulation as there are other implications to having a highly/lowly concentrated banking sector that must be considered. For example, questions concerning the impact of concentration on financial stability (see Allen and Gale, 2003).

[6] This is a very important point, particularly in Africa where the proliferation of banking services is an important part of financial development (Soludo, 2004).

On the other hand, allowing banking sectors to become highly concentrated also presents potential drawbacks. In addition to potentially weakening the IRPT, (Hannan and Berger (1991), Neumark and Sharpe (1992), and Cottarelli and Kourellis, (1994) suggest that highly concentrated markets pose the risk of collusive bank behaviour in which capital is rationed or made expensive to maintain high profits for the banks. Furthermore, there is empirical evidence refuting the notion that bank concentration is positively related to market stability as suggested by Allen and Gale (2003) and Beck *et al.* (2003). For example, Shehzad and De Haan (2009) actually find evidence supporting a negative relationship between the two where less concentrated banking systems are more stable during financial crises than more concentrated systems.

This debate has recently come to the fore as deregulation, liberalization and consolidation in the banking industry, reflected by growing mergers and acquisitions within and between countries, has increasingly prompted concerns about the greater market power enjoyed by banks and the subsequent impact on financial stability, the cost of capital and the effectiveness of monetary policy (Alegria and Schaeck, 2007: 2 and Jobst and Kwapil, 2008). This debate has been further compounded by the recent financial crisis (2007-) that has raised interest on the merits and demerits of highly concentrated banking industries, hence the need to revisit the implications of banking concentration on economic performance for which its impact on the IRPT is a crucial part.

Unfortunately, the bulk of the studies on the interest rate pass through (even without an explicit consideration for its relationship with banking concentration) have focused on Europe and the United States. A few studies have been conducted in developing countries while even fewer have focused on Africa, which is a shortcoming this study will aim to address.

1.2 AIMS AND OBJECTIVES OF THE RESEARCH

The aim of this study is to determine the relationship between the level of bank concentration (measured by the three firm concentration ratio (CR3) and the interest rate pass through in South Africa, Botswana, Nigeria and Zambia. This is in order to provide clarity on the debate in the African context where research has been scant. The question asked throughout the study will be whether or not higher concentration levels are seen to be consistently associated with either a

stronger or weaker pass through? More specifically, the study will endeavour to achieve the following goals:

(i) To determine whether there is a relationship between bank concentration and the *speed* of the adjustment of bank lending and deposit rates in response to Central Bank interest rate changes;

(ii) To determine whether there is a relationship between bank concentration and the *magnitude* of the adjustment of bank lending and deposit rates in response to Central Bank interest rate changes in either the short or long run;

(iii) To determine whether the speed and magnitude of the IRPT differ across countries and whether those differences are due to differences in the level of bank concentration;

(iv) To determine whether there is asymmetry in either the speed or magnitude of the IRPT and whether or not it is related to the level of bank concentration;

(v) To determine whether changes in the level of banking sector concentration over time are related to changes in the speed, magnitude and asymmetry of the IRPT, and

(vi) To articulate the policy implications of the findings.

1.3 MOTIVATION FOR THE STUDY

The merits of the investigation on whether there is a relationship between bank concentration and the IRPT have already been presented in Section 1.1. Section 1.3 now presents the motivation and key contributions made by this study.

This study is motivated largely by the need to contribute to the limited existing literature on the relationship between bank concentration and the IRPT in Africa. Moreover, it seeks to explicitly investigate this relationship where many other studies have simply inferred the presence or absence of a relationship from results of studies simply measuring the IRPT, industrial organisation theory or *a priori* beliefs without the presentation of empirical evidence. This study will not only investigate the presence of a relationship, but what the nature of that relationship is as well.

In addition, the study hopes to contribute to the body of literature by investigating the important issue of bank concentration and the asymmetry in the IRPT. Rather than simply taking the IRPT as a symmetric reflection of policy rates in bank lending and deposit rates, the measurement of asymmetric responses allows for the identification of conditional relationships between bank concentration and the IRPT. For example, where a relationship between bank concentration and the symmetric adjustment of lending rates cannot be observed there may be a clear relationship between the IRPT and bank concentration for only falling lending rates. In such a case the symmetric investigation would ignore the fact that bank concentration would be related to the effectiveness of expansionary monetary policy (when lending rates are expected to fall) and erroneously conclude that the IRPT is not related to the level of bank concentration.

Two important contributions made by this research relate firstly to the investigation of bank concentration and the long run impact of policy rates on bank rates when the underlying series are not cointegrated and secondly, the investigation of bank concentration and the asymmetric long run impact of policy rates on bank rates where the conventional method of asymmetric effect determination from series in first differences is inapplicable[7].

Additionally, one of the key concerns in studies on developing countries is the lack of sufficient information to carry out comprehensive analyses as conducted in developed countries. While this study is similarly constrained because of its choice of countries, there is sufficient information for this investigation to be undertaken and where informational constraints are met they are duly noted[8].

1.4 METHODS OF THE STUDY[9]

The aims of this paper will be achieved by an empirical analysis of monthly data on Central Bank/policy interest rates, average commercial lending rates and three to six month deposit rates spanning 14 years from 1994 to 2007 (International Financial Statistics (IFS) CD Rom - July 2009) and three firm concentration ratios (CR3) (A New Database on Financial Development

[7] To the knowledge of the author the combination of techniques used in the measurement of the IRPT in this study have not been applied in this context before.
[8] The desire to conduct an investigation in Africa and the availability of information and data were the critical considerations in the choice of countries for the study.
[9] A more detailed explanation of the methodology is available in Chapter 4.

and Structure 2007 in Beck *et al*, 2007 and World Bank, 2009)). Additional data is sourced from Central Bank annual reports.

In this study we measure the IRPT in the selected countries following Li (2003) and Aziakpono *et al*, (2007) and use the Engle and Granger (1987) cointegration method to ascertain whether the policy rates are in fact related to bank lending and deposit rates. Thereafter, to meet objective (i) we use symmetric and asymmetric error correction frameworks to identify the short run dynamics resulting from the cointegrating relationships. These error corrections, in turn, are then used to obtain mean adjustment lags (MALs) to ascertain the symmetric and asymmetric speed of adjustment of bank rates in response to policy rate changes. The resultant MALs are reviewed against the level of concentration to determine whether the speed of the IRPT is related to the level of concentration.

The magnitude of adjustment is measured following Brooks (2008) and Kwapil and Scharler (2009) in order to obtain symmetric and asymmetric measures of the magnitude of adjustment of deposit and lending rates to Central Bank rate changes for both the short run and the long run. These parameters are then compared to the level of concentration to meet objective (ii).

Objective (iii) will be met by comparing the symmetric speed and magnitude of the IRPT and the level concentration, as computed above, between the four countries for the entire sample period. Objective (iv) follows a similar procedure except that the comparison looks at the asymmetric speed and magnitude of adjustments and compares them to the level of concentration.

Objective (v) is met by conducting an analysis similar to that for the fulfilment of objectives (iii) and (iv) in that it is a comparison of speed and magnitude measures of the IRPT and the level of concentration. However, in this case the assessment is done for eight year rolling windows in each country[10].

The final objective is met following the conclusions drawn from the results of tests conducted to meet objectives (i) to (v).

[10] In line with Demirguc-Kunt *et al.* (2003) the concentration level is taken as the average of the annual concentration ratios over the sample period.

1.5 ORGANISATION OF THE STUDY

The rest of this study is organised as follows: Chapter 2 reviews the theoretical and empirical literature on the interest rate pass through, bank concentration and the relationship between them. Chapter 3 discusses some of the salient features of monetary policy and bank concentration in the countries under investigation with a view to providing some preliminary insight into the possible relationship between bank concentration and the IRPT. Chapter 4 presents the methodology and data used in the study. Chapter 5 presents the empirical results of the research. Chapter 6 provides a summary of findings, policy implications and areas for future research.

CHAPTER 2

A THEORETICAL AND EMPIRICAL LITERATURE REVIEW OF INTEREST RATE PASS THROUGH AND BANK CONCENTRATION

2.1 INTRODUCTION:

This chapter reviews the theoretical and empirical literature on IRPT and bank concentration. As noted in Chapter 1, this study merges a thorough analysis of the speed and magnitude of IRPT with an analysis of how this speed and magnitude vary as the level of concentration varies. To this end this chapter defines both IRPT and bank concentration and then reviews theory and studies on the relationship between IRPT and the level of bank concentration.

2.2 THEORETICAL LITERATURE

2.2.1 Interest Rate Pass Through Defined

Quayyum *et al.* (2005) describe IRPT as the process through which changes in policy dictated interest rates are translated into changes in bank lending and deposit rates. It is measured by the speed and the magnitude of the adjustment of the bank lending and deposit rates in response to changes in the Central Bank/policy determined rate. Further to this, the most desirable IRPT is one that speedily and completely reflects changes in the official rate in the bank lending and deposit rates[11].

In order to have a full and speedy IRPT it is crucial that bank lending and deposit rates remain sensitive to changes in policy determined rates (Gidlow, 2001). To do this Central Banks have at their disposal a variety of measures designed to maintain such sensitivity. Popular amongst them is the enforcement of a fractional reserve banking system in which compulsory bank cash reserves are held by the Central Bank to create a money market shortage that forces banks to seek "accommodation" at the policy determined interest rate. This system effectively makes the

[11] This is so that the monetary policy authority's decisions have a meaningful and timely effect.

policy rate the cost of funds for banks which are "compelled"[12] to borrow at the policy dictated rate.

Despite being able to describe and identify the IRPT as a conduit of monetary policy, the IRPT process does not have an explicitly stated theoretical basis (Hoffman and Mizen, 2001)[13]. Consequently, linking the IRPT and bank concentration requires a merger between an understanding of the IRPT and the understanding of bank concentration.

2.2.2 Bank Concentration Defined

Bank Concentration is a measure of the extent or degree to which a relatively small number of banks account for a relatively large percentage of the banking market (Alegria and Schaeck, 2007: 4)[14]. It can be measured in different ways and two of the most popular methods are explored below.

2.2.2.1 Concentration Ratios

Concentration ratios measure market concentration by dividing the asset holdings of *k* number of banks by the total assets of the banking industry. It is a relatively simple and very popular measure of bank concentration in the literature and the three firm ratio (CR3) is the most popular measure in applied work (Bikker, 2000) (Alegria and Schaeck, 2007). The CR3 is calculated as follows:

$$CR3 = \frac{\sum_{i=1}^{3} Z_i}{Z_t} \qquad (2.1)$$

Where *k* is 3, Z_i is the value of the assets held by an individual bank and Z_t is the total number of assets in the industry. Unfortunately, the measure does not take into account the number of

[12] This is a very simplified version of the process because the system of accommodation works beyond simply the activity of the Central Bank as the lender of last resort as implied here. The option to borrow from the interbank market also exists and this rate is also influenced by the policy rate. To get a comprehensive view of the interaction between banks and the Central Bank see Faure (2006) for an in depth analysis including how policy rates are still made effective without the presence of reserve requirements.

[13] However, there are theories (explored here) regarding why it may be made smoother/stronger or more rigid/weak but these are not actually IRPT theories but theories surrounding IRPT changes, for example, theories on bank behaviour.

[14] It is important to note that concentration is a *relative* measure and while absolute measures of what constitutes a lowly concentrated or highly concentrated market can be suggested these would be highly contentious and subjective in the very least. For the purposes of this investigation concentration is compared between countries and over rolling windows (see Chapter 4).

banks in the industry or the asset holding of banks outside the arbitrary three firm cut off (Bikker, 2000).

2.2.2.2 Herfindahl-Hirschman Index

Given the failings of the CR3 measure, a popular alternative is the Herfindahl-Hirschman Index (HHI). This index is calculated by squaring the market share of each firm competing in a market, and then summing the resulting numbers. As its computation considers the asset holdings of all the banks in the industry it avoids the concentration ratio's problem of having an arbitrary cut off. It is calculated as follows:

$$HHI = \sum_{i=1}^{n} \left(\frac{Z_i}{Z_t}\right)^2 \qquad (2.2)$$

Where *n* is equal to the number of firms, Z_i is the value of the assets held by an individual bank and Z_t is the total number of assets in the industry. The HHI can range from close to zero to 10,000; where a value close to zero indicates a sparsely concentrated market and 10,000 a monopoly (Abassoglu *et al*, 2007: 7). One immediate consequence of attempting to use the HHI is that asset holding data is necessary for all firms in the industry rather than just the total industry assets and the asset holdings of a few large firms. This can be problematic in cases where data is scant[15].

While the specific level of concentration can be measured in different ways, what unifies the theory is that increased market concentration ultimately results in a greater centralisation of market power in the industry. However, what is contentious is whether such a concentration of power in the banking sector should be viewed with grave concern or rather as the innocuous outcome of increasingly efficient industries.

2.2.3 Bank concentration and the IRPT

As noted earlier the question for monetary policy makers has been and still is one of identifying the barriers to a full and speedy IRPT[16]. It is regarding this question that pioneering researchers

[15] This point is revisited in the methodology where justification for the concentration measure taken in this study is presented.

[16] Put differently, policy makers have had to determine what could destroy the important positive relationship between market rates (bank lending and deposit rates) and official (policy determined) rates.

like Cottarelli and Kourellis (1994) suggested taking a look at the market structure of the banking industry to identify possible impediments to the IRPT.

In Cottarelli and Kourellis (1994) and subsequent work the focus was on determining what specifically about the structure of the banking industry caused the rigidities in the IRPT. Since the official rate was communicated directly to the banks, the inability to reflect its changes in deposit and lending rates had to lie in the banking industry. There were elements in the banking industry that were keeping bank lending and deposit rates unresponsive to policy rate changes (Jeon and Miller, 2002). Concentration in the banking sector arose in many studies as potentially being the source of such rigidities as high levels (low levels) of concentration appeared to provide disincentives (incentives) for swift bank responses to Central Bank interest rate changes. Consequently, banking sector concentration became a prominent feature in IRPT rigidity debates (Berger *et al*, 2003).

The issue amongst researchers still is, whether or not the concentration of the banking sector will result in efficient or inefficient pricing strategies by banks and how these will influence the rigidity of the IRPT and consequently the effectiveness of monetary policy transmission. Berger and Hannan (1989) summarise the impact of bank concentration on the pricing behaviour of banks in two conflicting hypotheses.

On one hand there is the "Structure-Conduct-Performance" (SCP) hypothesis that was pioneered by Bain. This hypothesis suggests that the structure of an industry will influence the conduct of its members which will in turn influence the performance of that industry. For example, an uncompetitive banking industry (structure) will most likely result in inefficient practices and a reduced incentive to quickly respond to monetary policy stance changes (conduct) resulting in a sluggish and incomplete IRPT and the poor conduction of monetary policy changes (performance).

The competing hypothesis is the "Efficient Market Hypothesis" (EMH) which suggests that concentration would increase the overall efficiency of the banking industry resulting in banks pricing their products more competitively. This is based on the understanding that increased concentration is due to more efficient banks growing more rapidly than less efficient banks, or

more efficient banks taking over less efficient ones. If this were the case, at least up to some point, banks would price their services more competitively[17], rather than less competitively.

In addition to these traditional hypotheses bank concentration could also result in asymmetric responses in deposit and lending rates when Central Banks changed their policy determined rates. If banks could exert their market power on their customers, it would be possible for financial institutions to adjust their interest rates asymmetrically. For example, lending interest rates could be adjusted relatively fast when official interest rates increase, but the adjustment might become sluggish during periods of expansionary monetary policy where official rates are declining (Tomasz, 2003).

There are hypotheses that offer explanations for asymmetries in the responses of lending and deposit rates to increases and decreases in policy determined rates. The first is the "collusive behaviour hypothesis" and the second is the "adverse consumer reaction hypothesis" both of whose effects are influenced by the level of concentration. The "collusive behaviour hypothesis" suggests that the more concentrated a market is, the more scope there is for banks to engage in collusive behaviour and price their products in an uncompetitive manner and weaken the IRPT. Under the "adverse consumer reaction hypothesis" bank lending and deposit rates may be sticky up and down respectively as banks fear a loss of customers should they meticulously follow changes in the Central Bank rates. (Berger and Hannan, 1989)

Challengers of the existence of a relationship between bank concentration and the IRPT refute the relationships suggested in theory. Rather they cite the importance of bank supervision, financial market regulation and the strict enforcement of measures that promote bank sensitivity to policy changes (for example, reserve requirements) as the real determinants of the strength or weakness of the IRPT and, by implication, any relationship observed between bank concentration and the IRPT is in fact purely coincidental (Seater, 2000).

Kot (2004) suggests that market structure does play a prominent role in IRPT determination by suggesting that different degrees of concentration in the banking sector provide incentives for different behaviour from banking sector participants. If market concentration is high, banks may

[17] Here the word "competitively" is taken to refer to pricing strategies that closely reflect the changes in the official rate. This is the case because the competition would remove the scope for large disparities in the two or for slow adjustments in the bank rates in response to official rate changes.

tend, for instance, to increase their interest rate margins in periods of falling interest rates by reducing their lending rates more slowly than their deposit rates. Similarly, in periods of increasing market rates, banks may try to delay a narrowing of their net interest margin by passing rising refinancing costs promptly on to their customers in the form of higher lending rates while delaying their revision of deposit rates. These actions would serve to weaken the IRPT.

In contrast, Van Leuvensteijn *et al.* (2008) suggest that there is no theoretical reason to believe that there would be a relationship between bank concentration and the strength or weakness of the IRPT. It is their assertion that an "error" in equating competition and concentration is the reason for conflicting theoretical and empirical evidence. According to them what other studies are in fact observing and providing theories on is a relationship between bank *competition* and a smooth IRPT and not between bank concentration and the IRPT.

Despite the caution sounded by Van Leuvensteijn *et al.* (2008) early work by Wrightsman (1971: 202, 203) importantly points out that Central Banks do not themselves directly change retail interest rates, rather they influence the conditions in which banks operate with the view that those conditions will induce the desired changes in the retail interest rates that are under the control of the banks[18]. Given this view of the interaction of the Central Bank and the banks, the degree of insulation banks have from the adverse effects of non-compliance is then related to their degree of non-compliance (weakening of the IRPT). Where high levels of market concentration are expected to provide insulation from competitive pressures to remain highly responsive to policy rate changes, increased concentration will weaken the IRPT.

So far the theoretical debate has looked at industrial organisation theory and identified the expectations that theorists have on their consequences on the possible relationship between bank concentration and the strength or weakness of the IRPT. It has not, however, identified a model explicitly linking the banking sector market structure to bank pricing decisions and consequently the IRPT. The Monti-Klein Model below is a leading authority in this regard (Brock and Franken, 2003).

[18] Essentially Central Banks try to "force" banks to act in the public interest by changing their lending and borrowing rates to suit the greater macroeconomic objectives of the economy. Unfortunately these public interests are often at odds with the rational profit seeking incentives of banks. Hence why, in cases where the incentive to strictly comply with Central Bank mandated official rates is weak, banks' responses are slow and incomplete.

2.2.3.1 The Monti-Klein model of banking microstructure

The Monti-Klein bank model is based on the assumption that there is a cost function for running a bank that depends on the aggregate value of the assets (*A*) being managed by the bank as well as other factors of production, such as capital and labour (*K, L*). In this model, under conditions of oligopoly the rational profit maximising spread in the retail rates ($r_L - r_D$) is a function of those factors of production, the aggregate value of bank assets, the semi elasticities of demand and supply (η_L, η_D) and very importantly, the number of banks in the industry (*N*). This is represented in the equation below.

$$r_L - r_D = \frac{1}{N}\left(\frac{1}{\eta_L} + \frac{1}{\eta_D}\right) + \beta_1 A + \beta_2 K + \beta_3 L \qquad (2.3)$$

Where r_L is the retail interest rate set by banks on lending and r_D is the retail interest rate set by banks on deposits.

Equation (2.3)[19] shows how profitability in the banking industry is influenced by the number of participants in the industry. More importantly (and relevant to this study) is that it presents the setting of bank lending and deposit rates as a function of the banking industry's market structure. As the number of participants and the asset holdings of a bank change it adjusts its lending and deposit rates to maintain its interest rate spread. Put simply, the model refutes the idea that rational profit maximising banks make decisions independent of the market structure in which they are in. Ultimately, this means that the IRPT should be related to the structure of the banking industry. This view of bank costs and their operation has been used in the work of Van Leuvensteijn *et al* (2008) and Corvoisier and Gropp (2002).

In addition, Corvoisier and Gropp (2002) go on to suggest that the strength of the IRPT may also be explained by banks' product-specific concentration indices. This would mean that it would be possible to draw misleading conclusions about the relationship between bank interest rates and banking sector concentration if the concentration in question was that at the industry level rather than the product level.

[19] This is synthesised from the more elaborate presentation of the Monti-Klein model in Van Leuvensteijn *et al* (2008).

In addition to the Monti-Klein specification of bank pricing behaviour, De Bondt (2002) puts forward a simpler marginal cost pricing method. The method suggests that a bank's interest rate (lending and deposit) "I^B" is equal to a mark up "*X*" plus a fraction "β" of the policy interest rate "I^M". Algebraically this is represented as follows:

$$I^B = X + \beta(I^M) \qquad (2.4)$$

Under perfectly competitive conditions the pass through parameter "β" is 1; which means that shocks in the official rates are fully reflected in the individual bank's interest rates. Should it be below one because of a lack of perfect information or bankers' resistance to monetary policy impulses, the changes in official rates are not fully reflected in the individual bank's interest rates. Equation 2.4 sets a model on which empirical investigations of IRPT can be conducted (see Chapter 4). In relation to concentration, where concentration can be found to influence "β", concentration can be seen to influence the IRPT.

2.2.4 Summary of Theoretical Review

This theoretical review presented the varying views on the theoretical relationship between the IRPT and bank concentration. Conflict reigned as to whether there was a relationship and if so whether it was negative as suggested by the SCP or positive as suggested by the EMH. Some evidence was presented to challenge the need to look at banking market structure to identify links it may have to a weak or strong IRPT while some theorists identified the false equating of concentration and competition as the root of the ambiguity on the matter. In addition it identified (through the Monti-Klein model) how the rational profit maximising decisions of banks may create a relationship between bank concentration and the IRPT.

What is however clear is that there is no clear theoretical evidence to refute or support the presence of a relationship between bank concentration and the IRPT, let alone whether such a relationship is positive or negative. It is thus imperative that an investigation of empirical literature be taken to find evidence on the *actual* relationship between bank concentration and the IRPT.

2.3 EMPIRICAL REVIEW

The empirical research on this topic has been primarily concerned with investigating reasons for retail rate rigidities in the light of official rate changes and so presents a myriad of factors that influence the IRPT, of which bank concentration is only one factor[20]. Researchers have aimed to present empirical evidence that explains these rigidities by tying them to a variety of factors relating to the banking sector's microstructure and its operation. More specifically, these papers have sought to explain the rigidity through structural characteristics of the banking sector, such as: the development of the banking industry, the ownership structure and the barriers to entry (Cottarelli and Kourelis (1994), Cottarelli *et al*. (1995)). Hannan and Berger (1991) and Mojon (2000) actually linked these rigidities to market concentration and the degree of competition while Weth (2002) and Berstein and Fuentes (2003) connected the rigidity to individual bank characteristics like bank size, liquidity, long-term customer relations, the type of customers and the risk associated with the loan portfolios of banks. Simply by looking at the conflicting conclusions drawn in these studies the clearest evidence on the presence and nature of a relationship is that there is no consensus on either the presence or nature of the relationship.

The rest of the empirical review is divided into an in-depth review of literature, firstly, on developed and secondly, developing countries[21].

2.3.1 Developed countries

The bias in the research on this topic is heavily slanted towards developed countries where data on interest rates and banking microstructure is plentiful and varied. This has allowed researchers investigating similar geographical areas to arrive at startlingly conflicting results.

A leading authority on the issue comes from the work of Cottarelli and Kourelis (1994) which first measured the speed of the adjustment of bank lending rates in 31 industrial and developing countries by regressing the lending rate on a distributed lag of money market rates. In this way, they estimated the effect on lending rates of shocks in money market rates following these

[20] This is to say that while the question of whether a relationship exists or not is indicated in a considerable amount of literature fewer studies have focused on explicitly investigating the relationship between the IRPT and bank concentration.

[21] As this study will focus on developing countries in Africa it would be prudent to review the outcome of research in different countries at different stages of economic development in order to provide some insight in what may be expected in the results of this study.

shocks after three months, after six months, and in the long run. Secondly, it explained the cross-country differences in these multipliers by regressing them on several variables related to the structure of the financial system, such as the degree of concentration in the banking industry, the existence of constraints on capital flows and barriers to entry, and the size and the efficiency of the money market. Using monthly data on lending, discount and money market rates from the Bank of International Settlements, they found that the degree of stickiness was quite different across countries, particularly in the very short run. The impact multiplier (defined as the change in the lending rate observed during the month in which the money market rate changes) was close to unity in some countries but as low as zero in others. Significant differences could also still be observed after three and six months. In the long run, however, the adjustment was close to unity for most countries. Banking sector concentration, however, did not have a significant effect on the pass through.

Cottarelli *et al* (1995) studied 63 banks in Italy from June 1986-December 1993. Using an error correction model on monthly data over the period they established that bank concentration did have a significant impact on the IRPT. In this work they highlighted how the preceding work of Cottarelli and Kourellis (1994) had tried to factor in concentration in their calculation by simply taking the market share of the five largest banks (CR5). Rather, in this study, they used the HHI. This allowed them to conclude that differences in the degree of lending rate stickiness among Italian banks was to a large extent due to the different degrees of concentration (as measured by the Herfindahl index) of the local loan markets in which banks operated: banks operating in less concentrated markets adjusted their lending rates faster.

In contrast to this finding, Berstein and Fuentes (2003) produced results that were similar to Cottarelli and Kourelis (1994). They found that the speed of adjustment was affected by banking sector expectations and interest rate volatility, but not concentration. Taking monthly data on deposit interest rates of different maturities in Chile from May 1995 to December 2002 and concentration ratios of the three largest (CR3) banks, the five largest banks (CR5) and the HHI, their study showed that bank interest rates responded by between 75% and 88% to changes in the interbank interest rate. The authors, however, conceded that their results were not in line with their expectations and so sought an explanation. In their research they found that concentration affected the coefficient of the lagged variables in their model and thus it had a long run influence

that could be missed in a short run analysis. From this they concluded that market concentration negatively affected the interest rate pass through. The only issue being one of when this effect would be felt in the pass through. Additionally, they could not find evidence of asymmetries in the pass through between changes increasing or decreasing interest rates.

Abbasoglu *et al* (2005) presented another study that refuted the link between the interest rate pass through rigidity and the level of concentration in the banking sector. Their study uses data from the detailed balance sheets of the banks that operated in the years from 2001 to 2005 in Turkey which they obtained from the Bank Association of Turkey. During this period the number of banks in the Turkish economy was decreasing due to mergers and acquisitions making the country an ideal candidate for comparative analysis as the trend over the years could be documented. In 2001 there were 61 banks while in 2005 there were 48. By taking the concentration ratios of the three largest (CR3) and five largest (CR5) banks and the HHI as measures of concentration and comparing them to the IRPT they were able to conclude that there was no support for a link between banking sector concentration and the IRPT.

However, having anticipated the possibility that their results may not provide conclusive results on the influence of banking structure and IRPT rigidities, Abbasoglu *et al* (2005) also took a Panzar-Rose[22] measure of competition to assess if it could provide a better explanation for interest rate rigidities in the banking sector. Of importance in their final results was the fact that even though concentration itself failed to explain the IRPT rigidity, competition appeared to be the likely influence of the rigidities. This result is particularly important when it is considered that opponents of the theoretical link between IRPT rigidities and the level of banking sector concentration argue that when the link is made in empirical studies the studies are often capturing the influence of competition rather than concentration. Additionally, since competition and concentration may be closely linked it is not difficult to envisage such a possibility[23].

Following this thread, Van Leuvensteijn *et al* (2008) took monthly data from the Bankscope database of banks on mortgages, consumer loans and short-term loans to enterprises in eight

[22] The measures of competition are not explained in this study but are available in the studies from which they are cited.

[23] Such a link exists where the performance of an industry (competitiveness) is greatly influenced by the structure of the firms in the industry (concentration). Where concentration is high, for example, competitive pressures may be abated by tacit collusion on the parts of the participating firm. In such a situation concentration and competition are closely and negatively related.

Euro area countries from 1992 to 2004; namely Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal and Spain. Using an error correction model and the Boone measure of competition on this panel data they concluded that all the bank loan rates did indeed respond significantly more strongly to market rates when competition was high and that, all in all, competition did make for stronger long-run bank rate responses to corresponding market rate changes. Furthermore, Van Leuvensteijn *et al* (2008: 16) suggested that many studies turn to concentration as a proxy for competition and so a considerable amount of research that has mapped interest rate rigidities against the level of banking sector concentration were in fact attempting to test these rigidities against banking market competition. For them, it was for this reason that concentration results yielded (and would continue to yield) ambiguous results.

Earlier work by Mojon (2000) had also suggested the influence of competition and not concentration as a factor determining the speed of the IRPT. By taking deposit and lending rates in six euro countries over two ten year periods from 1979 to 1988 and from 1988 to 1998 and applying an error correction model, he identified rigidities in the IRPT. However, in explaining his results he did not point to market concentration as an influence on IRPT rigidity; rather, he pointed to menu costs, bank expectations of the direction of monetary policy and implicit interest rate assurance as the significant factors hampering a smooth IRPT. These findings were supported by the work of Neumark and Sharpe (1992) that similarly identified menu costs and interest rate assurance, respectively, as the key factors in interest rate rigidities.

Corvoisier and Gropp (2002) decided on a more detailed product-specific measure of the impact of bank concentration on the determination of retail interest rates. They constructed a country-specific, product-specific Cournot model for EU countries for the period: 1993 to 1999. Additionally, the HHI was used rather than simple concentration ratios that exclude the consideration of small banks in their calculation. Their results showed that moderately concentrated banking markets (e.g. Belgium) in comparison to highly concentrated markets (e.g. the Netherlands) displayed differences in bank margins for loans by as much as 200 basis points. Furthermore, these results seemed to support the "structure conduct performance hypothesis," which suggested that higher market concentration would result in collusion.

Corvoisier and Gropp (2002) also investigated demand deposits and observed a similar result, where higher concentration was also associated with higher margins. In contrast, for savings and

time deposits, they found that higher concentration (again comparing Belgium to the Netherlands) resulted in margins, which were 100 to 200 basis points lower in more concentrated markets. For this the authors suggested that every market presented its own idiosyncratic features that encouraged varied responses from banks, for example, for products where rate change sensitivity by customers is high rate changes will be as mild and as infrequent as possible. This could result in compensatory adjustment in the rates of other products where resistance may be low and switching costs for consumers high.

Given the ambiguity presented by the product level analysis of Corvoisier and Gropp (2002) it appears that conflicting results on the relationship between concentration and retail interest rate adjustments may be a question of the specific product in question rather than a universal truth in favour or in opposition of their relationship.

De Bondt (2005) took average monthly data on the Euro area from January 1996 to May 2001. Using a vector error-correction framework to analyse the immediate and final pass-through and speed of the IRPT, he found that the immediate pass-through of market interest rates to retail bank interest rates was incomplete, in line with previous cross-country studies. The proportion of a given market interest rate change that was passed through within one month was found, at its highest, to be around 50%. The pass-through was higher in the longer term and notably for bank lending rates close to 100%. The most sticky retail bank interest rates in the euro area were the interest rates on overnight deposits and deposits redeemable at notice of up to three months with a long-term pass-through of at most 40%. To explain the differences in the pass through in the deposit and lending rates, De Bondt suggested a look at competition in the banking industry for an explanation. While this work leant towards competition rather than concentration as the reason for the rigidities it did not eliminate it as a possibility as was the case in some preceding work (Cottarelli and Kourelis, 1994 and Van Leuijenstein, 2008).

Although the work of Hannan and Berger (1991) did not explicitly tackle the question of interest rate pass through it did (like other papers on banking microstructure and price setting) test the structure conduct performance hypothesis in the US Banking industry. Given the dependence of the relationship of market concentration and IRPT rigidity on the Bain's S-C-P model, the ability to refute the model in the banking sector would also question the need to consider market

concentration when investigating IRPT rigidities[24]. They presented a regression of bank concentration on bank deposit rates using quarterly data on 470 banks from the Federal Reserve survey from 1983 to 1985 and taking CR3 and HHI as measures of concentration in the savings and loan market. The empirical results were strongly consistent with the implications of the structure-conduct performance hypothesis. Banks in the most concentrated local markets in the sample were found to pay MMDA (Money market deposit account) rates that ranged from 25 to 100 basis points less than those paid in the least concentrated markets.

2.3.2 Developing countries

While considerable research has been conducted in developed countries to establish the relationship between bank concentration and the IRPT[25] such research is not as plentiful in developing countries and is markedly scant in Africa. Scholnick (1996: 485) offers an explanation for this by noting that "data is typically unavailable in developing countries". Consequently, in the instances where research was done the researchers have had to attempt to answer the question with limited amounts of data. In Scholnick's (1996) investigation of asymmetries in the adjustment of commercial bank interest rates in Malaysia and Singapore he was forced to introduce a different approach, using only the time-series data that was available. Nonetheless, using cointegration and an asymmetric vector error-correction model, he investigated the IRPT from 1983:1 to 1992:11 for Malaysia, and from 1983:1 to 1994:4 for Singapore[26].

The main findings of this paper were that it identified differences in the adjustment of deposit rates in the two countries when they were different from a preset equilibrium level. Interest rates were rigid when they were below their equilibrium level than when they were above it. This implied that banks in these countries tended to adjust their deposit rates downward more rapidly than upward. Put another way IRPT would be different for increases and decreases in official rates[27]. By showing that IRPT could be described beyond being strong or weak, potential

[24] What Hannan and Berger (1991) were investigating was whether market concentration constituted a significant influence in the decision by banks to set deposit and lending rates.
[25] The bulk of the research has focused on the European Union and the implications that banking structure in individual countries will have on the effectiveness of Euro-level monetary policy.
[26] Data was obtained from the IMF's *International Financial Statistics* CD-ROM
[27] Given that theory also suggests that asymmetries may exist for deposit and lending rates (Debondt, 2003). The permutations for the IRPT are increased. In other words, the IRPT could be different if measured on deposit rates

relationships with bank concentration were opened, for example, where concentration may not have been related to a symmetric adjustment in deposit rates after Central Bank rate changes there may be a clear relationship between bank concentration and rigidity in the reduction of deposit rates.

In Pakistan, Quayyum *et al.* (2005) used monthly data on call money, deposit and lending rates in response to Treasury bill rate changes for a period spanning thirteen years from March 1991 to December 2004. By using Box *et al*'s "Intervention Approach" their results revealed that while the impact on call rates was immediate the impact on deposit and lending rates was sluggish. Given that the authors had anticipated the sluggishness, the reasons for it were suggested as twofold. Firstly, banks' menu costs played a significant part in the decision to adjust lending and deposit rates. Secondly, the oligopolistic structure of the Pakistani banking system accommodated sluggish deposit and lending rate responses in the face of T-bill interest rate adjustments.

Egert *et al.* (2005) looked at five Central and Eastern European countries – the Czech Republic, Hungary, Poland, Slovakia and Slovenia in order to determine the IRPT in these "transition economies". Using a single bi-variate error correction equation (as was popularly the case in the literature) and a cointegrated VAR framework on monthly data from 1994 to 2004 they established the following: there was a lower pass-through for overnight and long-term household deposit rates in Hungary, a moderately lower pass-through for deposit rates in Poland, a moderately lower pass-through for long-term corporate loan rates in Hungary and for short-term and long-term corporate loan rates in Poland. However, estimations failed to establish any significant relationship between monetary policy rates on the one hand, and deposit rates in Slovakia, as well as aggregate household loan rates (and consumer loan rates) in the Czech Republic and Slovenia. Having determined the existence of a subdued IRPT it remained for the authors to identify the cause of the rigidity. To this the authors pointed to banking sector competition and concentration. Additionally, they expected the increase of the latter in Poland and Slovakia to bring about an even weaker IRPT. One peculiarity in their results was the fact

after an increase in official rates, on deposit rates after a decrease in official rates, on lending rates after an increase in official rates and on lending rates after a decrease in official rates. Furthermore, if Hoffman and Mizen's (2005) identification of IRPT sensitivity to the size of the official rate changes are considered the permutations become considerably higher.

that their estimations of the strength of the relationship were lower than in previous estimations. This, they argued, was because previous studies had relied on error correction models without explicitly checking for cointegrating relationships.

In Columbia, Betancourt *et al.* (2008) used an error correction and a VARX[28] model based on a Monti-Klein interpretation of bank decision making. Using monthly data from 1999 to 2006 they found that their estimations implied that the short run interest rate pass-through to the deposit rate was incomplete while in the long run the transmission of a change in the policy rate was complete. To explain the rigidity they highlighted that the banking sector microstructure contained important information relating to the operation of the IRPT.

The analysis of empirical evidence on the IRPT and bank concentration does not leave one with a clear idea of the relationship between bank concentration and the IRPT. Rather it highlights strong contention over the relationship. It is because strong evidence exists in support and disagreement over the influence and the degree of the influence, of banking sector concentration on the smooth operation of the IRPT that an investigation of the relationship is merited in Africa. This is made particularly important given the critical role banks play in the monetary policy of developing countries (Egert *et al*, 2005).

2.3.3 Summary of Empirical Review

The empirical literature still suffers from the same ambiguity as the theory did on whether there is a relationship between bank concentration and the strengthening/weakening of the IRPT. It is particularly because of the little research into the field in developing countries and the fact that empirical evidence is conflicting that it is imperative that an Africa focused study be undertaken to answer the question in the African context. If empirical evidence had been unified in its assessment then the results from these studies could be extrapolated to the African case but this is not the reality. To assess whether decreasing or increasing bank concentration in Africa will harm or enhance the IRPT and consequently effective monetary policy requires investigations such as the one carried out in this study.

[28] This is similar to the conventional VAR model except it includes exogenous variables in the system.

2.4 CONCLUSION

The clearest observation, having reviewed the theory and empirical literature, is its disagreement in its conclusions. On one hand, the Structure Conduct Performance hypothesis suggests that high bank concentration will retard the IRPT while, on the other, the Efficient Market Hypothesis suggests that high bank concentration will be associated with a stronger IRPT. This ambiguity is further compounded by conflicting empirical evidence. As a result there is a need for an investigation in the African context to determine whether bank concentration is actually related to the IRPT in Africa as no theory or empirical evidence can simply be extended to the African case.

Given this need to actually perform empirical research to identify if there is a relationship between bank concentration and the IRPT in Africa, the next chapter now provides an overview of the four countries under investigation in this study.

CHAPTER 3

AN OVERVIEW OF MONETARY POLICY AND THE BANKING INDUSTRY IN THE SELECTED COUNTRIES

3.1 INTRODUCTION

Since one of the goals of this study is to draw policy implications for bank regulation and monetary policy from its empirical results, it is prudent that it presents a brief summary of the salient features of monetary policy and the banking industries of the four countries under investigation. This overview provides background information on the countries, an indication of what our empirical results are likely to be and it may also help to explain any intuitively unappealing results we may find[29].

The rest of the chapter is divided as follows: Section 3.2 outlines monetary policy in the countries, Section 3.3 presents the features of the banking industry and the evolution of the bank concentration, Section 3.4 charts the trend between bank concentration and the net interest rate margin between bank lending and deposit rates, and Section 3.5 shows official rates against bank lending and deposit rates. Finally, Section 3.6 concludes the chapter and provides some preliminary insight into the interaction between bank concentration and the level of interest rates in all the countries.

3.2 MONETARY POLICY

3.2.1 South Africa

The primary objective of monetary policy in South Africa is to protect the value of the currency in order to obtain balanced and sustainable economic growth in the country (Mboweni, 2000). To this end, the South African Reserve Bank (SARB) has adopted financial stability (through price stability) as the focal point of monetary policy. This inflation targeting framework has been in operation since 2000 and has been used with a view to limiting volatility and uncertainty in the price level. Critically, this stability in the price level is expected to attract investment with long term growth benefits (Mboweni, 2000).

[29] As cautioned by preceding work in developing countries, data is scant and this overview is crafted from a variety of sources to provide some insight into the countries under study.

In contrast, monetary policy in 1994 still used monetary aggregates as targets despite the fact that monetary aggregates had long since been abandoned by advanced economies (for instance, the UK and US). In addition, until the adoption of inflation targeting, the only revision in the focus of monetary policy was that the monetary targets were supplemented by an eclectic set of indicators, including exchange rates, asset prices, wage settlements and the balance of payments (Aron and Muellbauer, 2007).

Despite differences in the targets of monetary policy between the periods of 1994 to 2000 and 2000 to 2007 the Central Bank still enacted monetary policy through the impact of policy rates on bank lending and deposit rates (Aziakpono *et al*, 2007: 6). However, there were differences in how these lending and deposit rates were influenced. Before 1998, the SARB used the "Bank Rate System" which employed accommodation rates that offered limited liquidity to banks through overnight loans. However, from March 1998 the Central Bank used the "Repo rate system" which utilised repurchase agreements (repos) between itself and banks that were designed to finance the bank liquidity shortages created by statutory bank reserve requirements (Gidlow, 1998).

Since the implementation of the inflation targeting framework monetary policy has generally been effective in maintaining a controlled level of inflation within its targeted bracket of three to six percent. This target inflation level was successfully maintained until recently when mammoth inflationary pressure was created globally by unstable oil prices and global concern over financial markets (South African Reserve Bank, 2009). The fact that monetary policy has generally been successful is important to note as any evidence of a relationship between bank concentration and the IRPT in our empirical results must be interpreted in the knowledge that monetary policy targets have generally been achieved.

3.2.2 Botswana

The Bank of Botswana's monetary policy objective is to achieve a sustainable, low and predictable level of inflation. The Bank of Botswana uses open market operations and interest rates to affect demand conditions in the economy and ultimately the rate of price changes (Bank of Botswana, 2009). The management of policy follows a medium term forecasting framework

that uses a rolling window period of three years. Over the period the inflation forecast is measured against the prevailing monetary policy stance and the stance is adjusted appropriately.

Prior to 1989 monetary policy in Botswana was informed by a Keynesian "forced saving" approach that advocated a strong emphasis on investment spending for long term growth. This approach advocated strong controls over bank interest rates guided by the resolute belief that increased investment justified such financially repressive policies (Setlhare, 2004: 3). In 1989 the failure of the approach to lead to productive investment resulted in the adoption of market orientated approaches to monetary policy and the liberalisation of financial markets. In 1991 the Bank of Botswana began issuing Bank of Botswana certificates as part of its open market operations for monetary policy implementation and began its current market based approach to monetary policy implementation.

The transition did not change the focus on growth and stability in the price level. Until 2008 these objectives were pursued through targeting an inflation level that fell within predetermined annual bounds. These flexible target boundaries were set according to prevailing macroeconomic conditions which were designed to make the boundaries realistic and achievable. Ultimately this inflation targeting framework was set to contribute towards the broader national objectives of sustainable economic growth and development through the promotion of savings mobilisation and productive investment. Furthermore, the ability to effectively control inflation would also be expected to support the international competitiveness of domestic producers (Bank of Botswana, 2009).

However, this annual inflation targeting framework was questioned in 2007 after the failure of the Central Bank to maintain inflation within its target levels and the realisation that inflation could only be realistically achieved in the medium term because of the time lag for monetary policy to impact price developments (Mohohlo, 2008). The abandonment of the annual targets has not removed inflation targeting in Botswana, rather, the forecasting and targeting of inflation was revised to look at a rolling window period of three years (medium-term) rather than one year (Bank of Botswana, 2009).

At the end of 2007 the Bank of Botswana's monetary policy approach was still considered effective despite having problems meeting inflation targets hence the revision of the approach to

create longer horizons for inflation targets rather than a total abandonment of the framework (Bank of Botswana, 2009).

3.2.3 Nigeria

Monetary policy in Nigeria is focused on controlling inflation and maintaining a healthy Balance of Payments position in order to safeguard the external value of the national currency and promote an adequate and sustainable level of economic growth and development in support of the economic policy of the federal government. These goals are achieved by controlling money supply in order to enhance price stability (low and stable inflation) and economic growth (Central Bank of Nigeria, 2009).

Despite the growth in the popularity of inflation targeting the principal target for monetary policy is still the control of monetary aggregates. However, since the adoption of the Structural Adjustment Programme in 1986 the control of these aggregates has been achieved through the use of market instruments rather than credit ceilings and interest rate controls. Open market operations, complemented by cash reserve requirements, are now the principal tools of monetary policy implementation (Central Bank of Nigeria, 2009).

Implicit in this approach to monetary transmission is the knowledge that financial markets possess the depth and breadth to make the open market operations effective. Prior to 1986 financial markets were not developed enough for such an approach[30]

Monetary policy has generally been effective in maintaining its aim of a controlled level of inflation and at the end of 2007 Nigeria had single digit inflation and positive economic growth (Central Bank of Nigeria, 2009).

3.2.4 Zambia

The primary objective of monetary policy in Zambia is to ensure the maintenance of price stability to promote balanced macroeconomic development (Bank of Zambia, 2009). While single digit inflation is a key focal point for policy makers, reserve money is still the operating

[30] The need for financial system development ultimately led to the creation of many small banks as attempts to develop the financial system encouraged an increase in the number of banks. This was an increase that culminated in 89 registered banks and a need to force a consolidation of the banking industry in 2004 (Soludo, 2004).

target of monetary policy while broad money, defined as including the foreign exchange deposits of commercial banks (M3), is the intermediate target of monetary policy. In addition, the Central Bank operates a fractional reserve banking system in which it ensures that commercial banks are consistently indebted to the Central Bank (Bank of Zambia, 2009). This is designed to make banks more sensitive to Central Bank action.

Since the beginning of a strong effort in 1992 to liberalise the financial markets, the reliance of Zambian monetary policy on market-related tools for its implementation has increased. Where previously direct controls were sufficient to control monetary policy they are now only a small component of the arsenal used.

While the Bank of Zambia was able to set and maintain inflation targets until 2007, the ability to continue to do so has recently been questioned by the failure to meet its policy targets (Bank of Zambia, 2009). However, this failure has been largely attributed to global financial pressures on food prices and not a failure of the monetary policy framework (Bank of Zambia, 2009).

3.3 THE BANKING INDUSTRY

3.3.1 South Africa

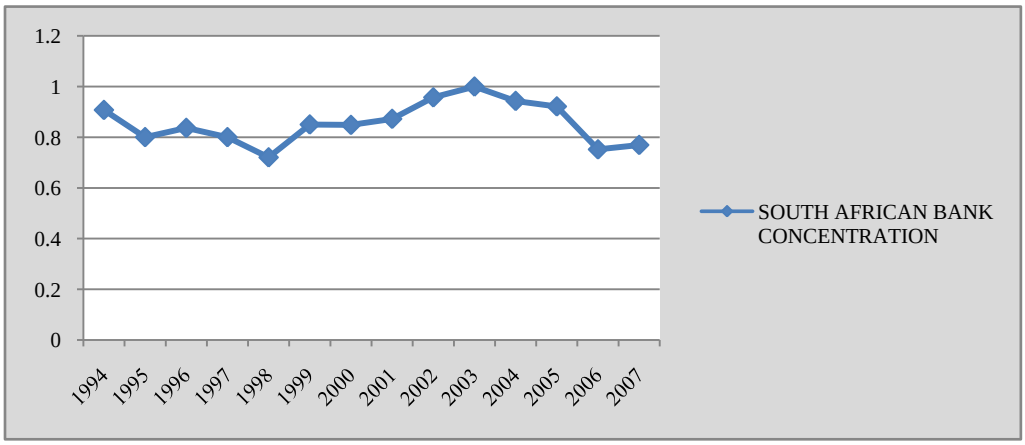
At the inception of democracy in South Africa in 1994 the banking industry was comprised of 35 registered banks of which the three largest were Standard Bank, ABSA and First National Bank (SARB, 1994). With democracy came the reintroduction of the country to the international community and the emergence of a large previously repressed population that encouraged an increase in the number of banks. At this time a Policy Board for Financial Services and Regulation (est.1993) was in place and operated on the leading principle of competitive neutrality. What was evident in the formation of such a body was the concern that the banking industry structure required monitoring to ensure its expansion was not coupled with weak competition and monopoly pricing. Even as early as 1993 the issues of the implication of the market structure in the banking industry were considered to be of paramount importance. However, Falkena's (2004) identification of a "complex monopoly" in the South African banking system suggested that the concerns over competition actually materialised.

From 1994 to 1998 the increase in participation in the industry and the expansion of the market slowly diluted the concentration of the banking industry. There were 39 registered banks in 1998 but the industry still remained very concentrated and the top three banks of 1994 remained unchanged. However, after 1998 (as Figure 3.1 shows) the banking industry concentration began to increase. Only in 2003 did the declining trend in the bank concentration return. One possible reason for the change in 1998 can be attributed to Russia's default on its public debt. Such a major default would have invariably increased uncertainty and fear in financial markets around the world, leading to a movement of funds to established market participants. However, by 2003 the highly publicised collapse of Saambou Bank had effectively been dealt with by bank regulatory authorities who, in so doing, would have improved consumer confidence and consequently, increased the market share of smaller banks.

At present the concentration of the banking industry has come to the fore as the sub-prime mortgage crisis of 2007 has renewed debate on the banking concentration-stability nexus. The relatively strong performance of the highly concentrated South African banking industry has necessitated the need to investigate whether a high concentration of the banking industry is necessarily an unhealthy position as the merits of a strong banking sector during a crisis seem vindicated by the relative lack of crisis in the South African banking industry while global banking industries struggle.

Figure 3.1 is a graphical representation of the trend in the three firm concentration ratios from 1994 to 2007:

FIGURE 3.1: BANK CONCENTRATION IN SOUTH AFRICA



Source: Adapted from a New Database on Financial Development Structure 2007 (World Bank, 2009). (The vertical axis denotes the proportion of the market held by the three top firms while the horizontal axis presents the year)

As illustrated above, bank concentration in South Africa has fallen between 70% and 10% over the sample period. There was an annual decline in concentration from 1994 until 1998 when concentration was at it s lowest level at 72%. Thereafter it rose to a peak close to 100% in 2003 after which it declined to a level of 77% in 2007. On average bank concentration was 88%, the second highest level in the sample of four countries.

3.3.1 Botswana

In 1989 the monetary authorities in Botswana decided to depart from the "forced savings approach" of the Keynesians that advocated a system of investment promotion even at the expense of negative real interest rates (Setlhare, 2004). Instead they adopted a system of liberalisation in which exchange rate controls[31] were relaxed and banks were given more discretion in setting interest rates in order to draw more participants to the banking sector. By relaxing exchange and interest rate controls the Bank of Botswana effectively broke the two firm duopoly held by Barclays Bank and Standard Chartered Bank (Kayawe, 2003: 5).

By 2000[32] the number of registered commercial banks had increased to five from the two in 1989. Despite the increase in the number of banks, and consequently the dilution of industry concentration, Barclays Bank and Standard Chartered still dominated the industry. In

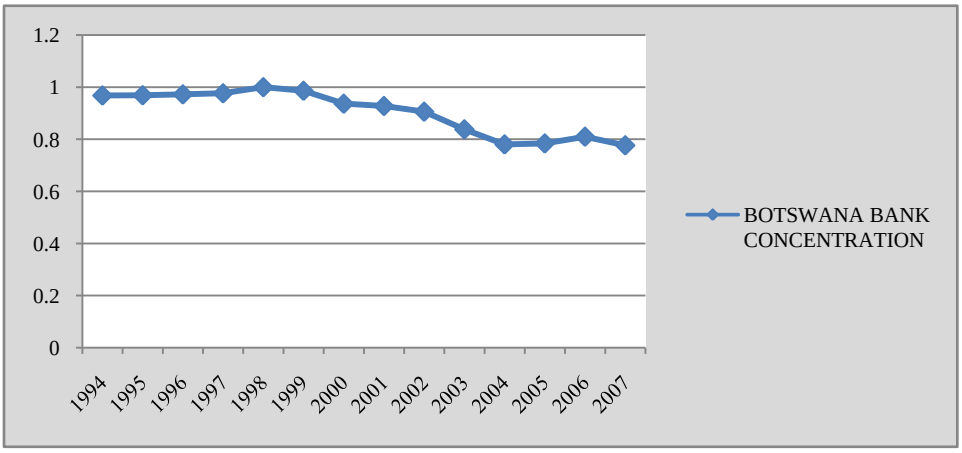
[31] This provided greater scope for profiting from international transactions.
[32] Accessible online Bank of Botswana Bank Supervision Reports start in the year 2000.

combination with First National Bank of Botswana they were the top three banks in the country. This can be seen in the concentration data in Appendix H, where market concentration is falling but remains above 95% still suggesting a very high level of concentration.

By 2007 there were seven registered banks and even though the top three banks remained unchanged, the market was less concentrated than it had previously been. In our sample, at a three firm concentration level of 77% the three firm concentration of the industry was still higher than most advanced countries (see World Bank, 2009) but it had fallen 23% since its 1998 peak of 1.

Over the study period the focus in Botswana was one of allowing increasing numbers of banking sector participants to develop its financial system. Below is a graphical representation (Figure 3.2) of the trend in the three firm concentration ratios from 1994 to 2007:

FIGURE 3.2: BANK CONCENTRATION IN BOTSWANA



Source: Adapted from a New Database on Financial Development Structure 2007 (World Bank, 2009). (The vertical axis denotes the proportion of the market held by the three top firms while the horizontal axis presents the year)

The trend shows a general decline in the level of bank concentration over the period. Bank concentration begins at 97% in 1994 and "settles" at 78% in 2007 while averaging 91% over the entire period. This makes Botswana the country with the highest level of bank concentration in our sample.

3.3.2Nigeria

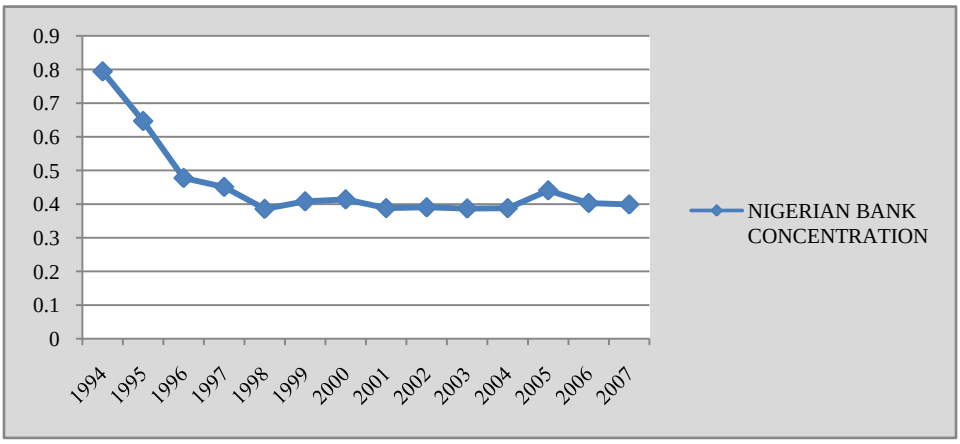
At the end of 2007 Nigeria had 24 registered banks of which the three largest banks were First National Bank, Union Bank of Africa and Intercontinental Bank (Central Bank of Nigeria, 2008). The number of banks in 2007 was a dramatic reduction from the 89 registered banks operating in 2004 before the Central Bank undertook a bank consolidation exercise in July 2004. The exercise increased reserve requirements from two billion Naira to 25 Billion Naira to force consolidation in the industry because of concerns that the banking industry structure (characterised by many small banks) was not designed to succeed in an environment of growing "internationalisation of finance" (Soludo, 2004: 2).

Prior to this, Nigeria had sought to tackle the challenge that internationalised finance posed by deregulating the financial sector. This had culminated in the increase in the number of banks without significant growth in the size of the banks. One of the problems this posed became a supporting point for the consolidation exercise. Despite the number of banks, the proliferation of banking services still lagged behind countries characterised by fewer banks. For example in 2004 Korea had eight banks with over 4500 branches while all 89 Nigerian banks had only 3300 branches and a combined asset base less than that of just one of the big banks in South Africa (ABSA) (Soludo, 2004: 5).

Before the consolidation exercise the Nigerian banking industry was characterised by several bank failures. Between 1994 and 1998 the economy had 31 banks that failed that reduced the concentration of the banking industry[33] (Central Bank of Nigeria, 2009). Figure 3.3 is a graphical representation of the trend in the 3 firm concentration ratios from 1994 to 2007:

[33] It is important to note that there may be cases the data may appear to disagree with intuition regarding the trend in concentration after a significant change to the industry but this may come down to the measure of concentration used rather than actual discrepancies. For example, the 3-firm concentration may fall after a reduction in bank numbers because of the growth of banks outside the three firm limit. For example the bank consolidation exercise in 2004 appears to record only a slight increase in concentration despite drastically reducing the number of banking sector participants.

FIGURE 3.3: BANK CONCENTRATION IN NIGERIA



Source: Adapted from a New Database on Financial Development Structure 2007 (World Bank, 2009). (The vertical axis denotes the proportion of the market held by the three top firms while the horizontal axis presents the year)

As shown above, bank concentration can be divided into two periods: an initial period from 1994 to 1998 where bank concentration is declining and a subsequent period from 1999 to 2007 when concentration did not significantly vary. Over the entire period bank concentration falls between 39% and 80% and averages 67%, which is the lowest concentration of our four sample countries.

3.3.3 Zambia

Since the adoption of financial reforms in 1991 that led to a more liberalised financial sector, the Zambian banking industry has been characterised by several problems that include the collapse of major banks and the stunted growth of national banks (Musonda, 2008). The desire to grow the financial sector resulted in low capital requirements for bank start-ups. For as little as 20 000 US dollars a bank could be registered and so by 1997 twelve new banks had been given licenses (Zambia News Online, 1997). Unfortunately, the expansion in bank numbers was not matched by an expansion in the demand for banking services and so from 1995 to 1998 six banks were liquidated (Musonda, 2008). However, fearing that the collapse of banks could result in further financial sector instability tighter regulatory measures (that included higher capital requirements) were taken and from 1999 to 2007 only three banks failed.

Despite growing numbers in banking participants the industry was still highly concentrated in the 1990s as Barclays Bank, Standard Chartered Bank and the Zambia National Commercial Bank maintained their market shares as consumers feared potential failure amongst the new banks.

Only since the more stringent controls in 1999 did bank concentration begin to decline again as it had when the financial liberalisation had first been introduced. This is illustrated in Figure 3.4 below.

FIGURE 3.4: BANK CONCENTRATION IN ZAMBIA

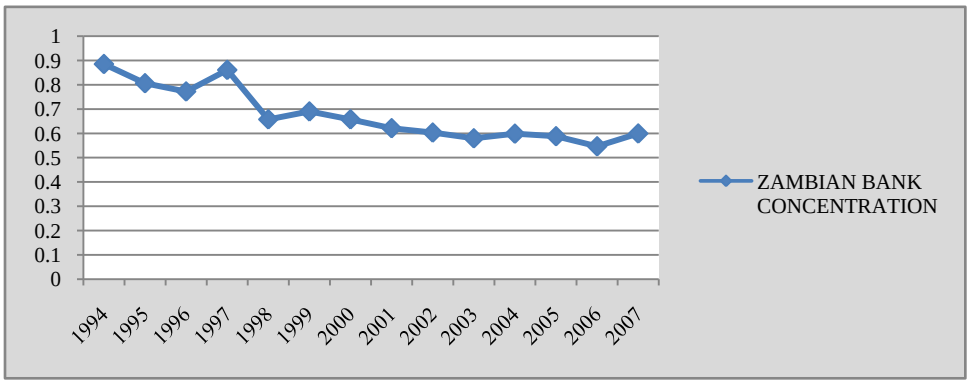


Figure 3.4: Adapted from a New Database on Financial Development Structure 2007 (World Bank, 2009). (The vertical axis denotes the proportion of the market held by the three top firms while the horizontal axis presents the year)

The trend in bank concentration in Zambia is one of general decline. Bank concentration fell from 81% in 1994 to 60% in 2007. As with Nigeria, the desire for financial sector development diluted bank concentration but came at the cost of greater instability in the banking sector. To compensate for this, the approach in Zambia was similar to the one that was later adopted in Nigeria in which bank capital requirements rose from US$20 000 to US$1.7 million in December 1996 and effectively forced banks to merge or face the possibility of getting their licences revoked (Zambia News Online, 1997). This served to bring stability to the level of concentration that hovered around 60% from 1999 to 2007.

In all four countries bank concentration was changing as the desire for financial development in these African countries began with very liberal financial reforms that led to greater market participants and lower concentration levels but ultimately, due to failing banks, resulted in either an explicit or implicit desire for consolidation of the banking industries. The important question posed to researchers by this changing bank concentration is one of determining what its consequences are given the recent financial sector history of the African countries.

3.4 BANK CONCENTRATION AND THE NET INTEREST RATE MARGIN

One key implication of the Monti-Klein model discussed earlier is that bank market structure should be related to the net interest rate margin. This model added to the Structure Conduct Performance Hypothesis (SCP) and the Efficient Market Hypothesis (EMH) suggests that interest rate margins between deposit and lending rates should vary with bank concentration. If the SCP holds then profit seeking by banks will result in higher margins as concentration rises, if the EMH holds then interest rate margins must fall as concentration increases. In both cases, regardless of the theory chosen, the suggestion is that bank concentration should be related to the net interest rate margin. (The graphs of bank concentration against the net interest rate margin are presented in Section H of the Appendix):

In South Africa there is evidence that bank concentration is negatively associated with changes in the net interest margin. From 1994 to 1997 there is a positive relationship between them; where concentration rises the net interest margin falls and where concentration falls, the net interest margin rises. The same trend is identified from 2001 to 2004 where a similar relationship can also be seen. In evidence that not only suggests that bank concentration can be related to the net interest margin, and by extension the setting of bank lending and deposit rates, the relationship supports the assertion of the SCP that where concentration is increasing collusion will rise and net interest margins will increase to increase bank profits.

In Botswana a similar relationship can also be seen with increasing concentration between 1995 and 1997 being associated with increasing net interest margins and falling bank concentration from 1999 to 2001 being associated with falling net interest margins. This reinforces the support for the SCP provided by the South African data.

Nigeria does not present a discernable pattern between the changing levels of bank concentration and the level of the net interest rate margin. However, while this does not mean that bank concentration is not related to the IRPT in Nigeria, it does indicate discord between the setting of bank lending and deposit rates and the banking sector concentration.

Evidence from Zambia is not as strong as South Africa and Botswana but it does indicate that from 2001 to 2003 there is a positive relationship between bank concentration and the net interest margin. Over the period falling bank concentration is associated with falling net interest

margins. This is yet more support not just for the presence of a relationship but that the relationship can be explained by the SCP.

What the graphs indicate is some evidence that there is a relationship between bank concentration and the setting of bank lending and deposit rates. The relationship may not hold for all periods but it does provide support for the SCP. It also suggests that the IRPT should show evidence of a relationship with the level of concentration since the level of concentration appears to be associated with the setting of lending and deposit rates[34].

3.5 OFFICIAL/POLICY RATES AGAINST BANK LENDING AND DEPOSIT RATES

At the core of this investigation is the relationship between official interest rates and bank lending and deposit rates which we have noted as the IRPT. While more formal tests are conducted to establish the long run relationships between them we present a preliminary analysis of their trend to see if they trend together and whether any variation in the trend can be explained by the level of bank concentration. (The graphs plotting official interest rates, bank lending and deposit rates in the four countries are in Section G of the Appendix).

As illustrated, there is a clear positive trend for the policy, lending and deposit rates in South Africa suggesting a close relationship between these interest rates. In Botswana and Zambia the trend is clearest between the policy rate and the lending rate, while the trend with deposit rates is not as strong. Nigeria presents the weakest trend amongst the interest rates. While the general pattern of rates shows a positive relationship, like in the other countries, the movement is not as closely related. In the context of bank concentration the countries with the first and second highest level of concentration have the clearest trends while the countries with the lowest concentration in our sample do not display a similar clarity. The country with the lowest level of concentration presents the "poorest" evidence of a trend.

These graphs do not actually present the strength and magnitude of the IRPT but they do show which countries exhibit the closest trends in the policy, lending and deposit rates and *possibly* which of them has the strongest IRPT. If the indication holds, then the EMH finds support as it is

[34] This is an intuition in keeping with Wrightsman's (1971: 202-203) point, discussed in the literature review, that since the IRPT falls down to the decisions by banks to set their lending and deposit rates, any indication that bank concentration affects those decisions suggests that bank concentration should play a factor in determining the speed and magnitude of the IRPT.

the country with the lowest concentration that appears to have the poorest trend of policy rates, bank lending and deposit rates.

However, it is important to note that this analysis does not actually reveal the strength of the IRPT. Rather it reveals that these rates tend to move together which has an important bearing on the policy implications of the results[35].

3.6 CONCLUSION

This chapter provided a brief insight into monetary policy, bank concentration and the results we might receive from an empirical analysis of the four countries. However, this overview provided some intuitively unappealing evidence supporting both the SCP and the EMH as the true representation of the relationship between bank concentration and the IRPT. While the analyses conducted are not sufficient to answer the question posed by this study, they do reveal that policy, lending and deposit rates are generally trending together and that the bank concentration can be related to the setting of lending and deposit rates and consequently the IRPT. Additionally while there may be no clear congruence in the specific nature of the relationship between bank concentration and the IRPT in the sample countries, these preliminary analyses suggest that there is at least a relationship.

Since a more thorough analysis is necessary before conclusions can be drawn as to whether a relationship truly exists between bank concentration and the IRPT and what the nature of that relationship is, the next chapter presents the methodology for testing the relationship in this study.

[35] This is because even if this study finds evidence that the bank concentration negatively affects the strength of IRPT the fact that the rates trend together suggests that monetary policy can still be made effective. The only difference would relate to an increase in the time taken for changes in policy rates to be reflected in bank rates and a reduction in the size of the response of bank rates. Both these are elements that can be accounted for when setting the policy rates, for example, by setting rates well in advance of the desired changes in the bank lending and deposit rates and changing them by more than the desired change in the bank lending and deposit rates. Evidence of a slower and smaller IRPT is not necessarily evidence of doomed monetary policy. A clear illustration of this is that Nigerian monetary policy has been successful in achieving its goals of single digit inflation and positive economic growth despite having the poorest trend in our analysis.

CHAPTER 4

METHODOLOGY AND DATA DESCRIPTION

4.1 INTRODUCTION

Pursuant to the objectives of this study, as set out in Chapter 1, Chapter 3 presented the analytical framework used to investigate the relationship between banking sector concentration and the effectiveness of monetary policy via the IRPT. Additionally, as noted in the objectives of the study, the methodology will set out the framework for a thorough assessment of the IRPT with a view of comparing its strength or weakness with the level of banking sector concentration. The procedures set out below will be used for the investigation on both the levels of analysis identified in Chapter 1.

The rest of the chapter is organised as follows: Section 4.2 discusses the empirical model. Section 4.3 covers the tests for stationarity. Section 4.4 examines the tests for cointegration. Section 4.5 discusses the symmetric and asymmetric error correction/equilibrium models. Section 4.6 deals with the mean adjustment lags. Section 4.7 discusses the symmetric and asymmetric magnitudes of adjustment. Section 4.8 shows how the IRPT is measured against bank concentration. Section 4.9 provides a description of the data used in the study and section 4.10 concludes the chapter.

4.2 THE EMPIRICAL MODEL

To start, there must be a primary model that presents the relationship between the bank lending/deposit rates and the Central Bank rates in order to conduct an IRPT analysis. As discussed in the literature review, De Bondt (2002) presents a marginal cost pricing method for banks that links changes in bank rates to changes in official rates (see Equation 2.4). Taking this method as being reflective of the true relationship between bank rates and official rates, the IRPT can be represented by a relatively simple bi-variate linear expression which is presented in Equation 4.1. This expression of the IRPT is in keeping with other IRPT literature (c.f. Scholnick, 1996 and Aziakpono *et al*, 2007).

$$y_t = \alpha_0 + \beta_1 x_t + u_t \qquad (4.1)$$

Where y_t is the endogenously determined bank deposit/lending interest rate, x_t is the policy/ Central Bank dictated rate, α_t is the intercept, β_1 is the slope parameter that shows the fraction of the change in official rates that is reflected in changes in the bank rates. For example, when β_1 is equal to 1 then the change in policy rates is fully reflected in bank rates, but when β_1 is 0.5 then only half the change in policy rates is reflected in bank lending and deposit rate changes. If the magnitude of IRPT adjustment changes then it is the size of $\beta_1$that varies. If the speed of IRPT adjustment is slow then the time taken for β_1 to be fully reflected in the bank lending and deposit rates is slow. The final component of the equation is u_t which is a stochastic error term.

Setting a model such as Equation 4.1 is useful for three reasons in this study[36]. Firstly, presenting the bank rates as endogenous and the Central Bank rates as exogenous in a bi-variate model informs the study as to which cointegration framework is most appropriate to test the presence of long run relationships between the variables. Secondly, it gives an indication of the error correction that will occur in the presence of cointegration. Thirdly, it provides a model for the computation of the long run and short run impact of Central Bank rate changes on bank lending and deposit rates.

Once an appropriate model has been drawn it is imperative that the variables entering Equation 4.1 are tested for stationarity to ensure that OLS (Ordinary Least Squares) estimations of the relationship between the bank and Central Bank rates are not spurious (Brooks, 2008: 319). The need for such stationarity tests is increased by the fact that the study uses time series data, which is usually not stationary (Gujarati, 1995: 806).

4.3 TESTING FOR STATIONARITY

Standard OLS estimation requires that the series used are stationary i.e. that they are of constant mean, variance and autocovariance. Such series are denoted as I(0) which means that they do not require differencing to bring about stationarity as they are stationary in level terms. Stationarity is important for three reasons: firstly, statistical inference is compromised by results of tests on non-stationary series because they often produce *spurious regressions*. In such cases two unrelated variables that are trending together could produce high R^2 statistics and statistically significant coefficient estimates which seem to suggest that the variables are related even when

[36] Each of these three points is fully explained in subsequent sections of this chapter.

this is not actually the case. Secondly, valid hypothesis testing is impossible as the standard assumptions for asymptotic analysis are not valid. This is because the *t*-ratios will not follow a *t*-distribution and the *F*-statistic will not follow an *F*-distribution. Thirdly, shocks to a particular variable in the system do not gradually die away as would be expected, rather they will be seen to persist or even grow in influence over time (Brooks, 2008: 319-320). It is because of the maladies of using non-stationary data that it is necessary to conduct tests to establish whether the series to be used in this research are stationary or not.

There are different ways to test for stationarity: visual plots, autocorrelation functions, unit root tests and stationarity tests (Brooks, 2008). This study uses two popular tests. The first is a unit root test (ADF test) and the second is a stationarity test (KPSS test). Since the two tests are very common and have been extensively used in empirical literature, only a brief description is provided here. For a detailed description of stationarity and unit root tests see Brooks (2008: 320).

4.3.1 The Augmented Dickey-Fuller (ADF) test

The ADF test tests for stationarity in a series by determining whether or not a time series has a unit root or not. This test is conducted under the null hypothesis that there is a unit root in the series i.e. it has a null of non-stationarity. Despite its common use the ADF test suffers from a low power in determining stationarity or non-stationarity when a stationary process has a root close to the non-stationary boundary[37]. To help overcome the low power of the ADF test a stationarity test can also be used to compliment the unit root investigation.

4.3.2 The Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test

The KPSS test is a stationarity test with a null hypothesis of trend stationarity. It assesses stationarity based on the residuals from the OLS regression of the dependent variable on the explanatory variables for which it calculates an LM statistic which can be measured against KPSS critical values (Kwiatkwoski *et al*, 1992).

[37] This happens because classical hypothesis testing does not accept the null hypothesis but rather rejects or fails to reject it. So a null hypothesis may fail to be rejected because it was correct or there was insufficient information for it to be rejected (Harris, 1995).

Brooks (2008: 321) suggests the use of "confirmatory data" analysis in which the two tests are used together to ensure that conclusions regarding stationarity, or the lack thereof, are robust. This study uses both tests.

4.3.3 Resolving the problem of Non-stationarity

There are a few remedies that can be used to cope with the problem of stationarity. Firstly, stationarity can be induced in a non-stationary series by differencing it (taking and using the first differences of the series rather than the series in level terms). Although this brings about stationarity it does so at the risk of misspecification and the loss of long run information embedded in the data. However, where non-stationary variables are seen to be stationary when combined they can be used in regression analysis and statistical inference without differencing the series (Brooks, 2008).

When a combination of non-stationary series I(d) results in a stationary process the series are said to be cointegrated. Generally, the linear combination of two non-stationary series will also be non-stationary and will be integrated at the same order of integration as the highest order of the non-stationary variables included in the system (Brooks, 2008). For example, two series of I(1) and I(2) will have a linear combination of I(2) which will also be non-stationary. It is only where the series are said to be cointegrated that a linear combination of I(1) and I(1) variables result in a I(0), process which is stationary (Brooks, 2008:318). Such a process has the benefit of allowing long run relationships between the variables to be investigated as long run dynamics imbedded in the data are not lost since the series are not differenced to make them stationary. Essentially, different series may be seen to exhibit a non-stationary trend but are cointegrated if they are trending together.

Knowing that the existence of cointegration would allow a thorough investigation of long run relationships in time series data this study investigates the ways in which cointegrating relationships can be identified and used.

4.4 TESTING FOR COINTEGRATION

There are two prominent ways of establishing the existence of cointegration between series of non-stationary variables. The first is the Engle-Granger 2 step model and the second is the Johansen technique (Johansen (1988) and Johansen and Juselius (1990)).

4.4.1 The 2 step Engle and Granger approach

The Engle and Granger (1987) approach estimates a single cointegration regression equation using OLS and then tests its residuals for stationarity. It begins with the estimation of "the cointegrating regression" (Equation 4.2) which is an OLS estimation of the empirical model presented in Equation 4.1:

$$y_t = \alpha_0 + \beta_1 x_t + u_t \qquad (4.2)$$

In this equation the variables are the same as in Equation 4.1 but in this cointegrating regression the residuals (u_t) are obtained and tested for stationarity. If the residuals are I(0) then the bank rates and official rates series are cointegrated (Brooks, 2008: 321). Stationarity of the residuals is tested using the ADF test by estimating the following equation:

$$\Delta u_t = \psi u_{t-1} + \sum_{i=1}^{p} \alpha_{i_i} \Delta u_{t-i} + \varepsilon_t \qquad (4.3)$$

The null hypothesis in these tests is still one of non-stationarity where H_0: $\psi = 0$: $u_t \sim I(1)$. This is to say that the null hypothesis is that there is a unit root present in the series. The alternative hypothesis is H_1: $\psi < 0$: $u_t \sim I(0)$ which suggests that the series does not have a unit root and is thus stationary. From Equation 4.3 the absolute value of the calculated statistic is compared to the *Mackinnon* critical value. If the calculated statistic is less than the critical value then we fail to reject the null hypothesis (implying non-stationarity) (Chinzara and Aziakpono, 2009). Essentially, if the residuals are stationary the variables are cointegrated. If not, the variables may not be cointegrated or may be integrated at orders greater than 1[38].

It is important to note that while the cointegration test under the EG approach uses an ADF test similar to the one used in the stationarity analysis for the single time series there are three major

[38] It is important to note that the EG approach requires all variables to be *I*(1). If they are not the residuals will be non-stationarity. Where the order of integration exceeds 1 then the estimation must be done on a model containing first differences (Brooks, 2002).

differences. Firstly, the ADF equation for the cointegration analysis does not have an intercept term, which we would expect, since the OLS residuals are expected to be centred around zero. Secondly, the ADF critical values are replaced with *Mackinnon* critical values since the single series critical values of the ADF test are not appropriate for the residuals of the two series equation (Enders, 2004: 439). Thirdly, the critical values vary depending on the number of variables and observations in the sample being tested (Harris, 1995). In this study two sizes of sample periods for two variables are used (168 observations and 96 observations)[39] and their corresponding critical values are: 1% (-3.954), 5% (-3.368), 10% (-3.067); 1% (-4.008), 5% (-3.398), 10% (-0.3087) (Enders, 2004: 441).

Despite providing a relatively simple cointegration framework the EG approach has been criticised for suffering from a finite sample problem that results in a lack of power in performing unit root and cointegration tests. It is also not possible to perform hypothesis tests about the actual cointegrating relationship[40]. Additionally critics of the EG framework note that it suffers from a simultaneous equation bias as it cannot allow for causality relationships that run in both directions. For example, in cases where *y* impacts on *x* and *x* impacts on *y* a researcher will be forced to treat the variables asymmetrically even though there may be no theoretical reason to do so. Should the researcher make an error in selecting which variable to make endogenous and which to make exogenous in the first stage (the OLS estimation) the error will be carried through to the cointegration stage (Brooks, 2008: 318-322).

One important benefit provided by the EG approach is that in addition to the residual based test there is scope for the use of two additional tests to ensure that the results it finds are robust. These two tests are the Cointegrating Regression Durbin Watson (CRDW) test and the Error Correction Coefficient (ECM) test and they are described below.

[39] These sample sizes reflect the entire sample period and the rolling window periods used in the two level analyses described earlier in this study.

[40] A revision of the EG approach, the Engle and Yoo (1987 in Harris, 1995) 3 step approach attempts to allow hypothesis testing by taking into consideration updated estimates of the cointegrating vector and its standard errors. Despite this the Johansen procedure is the technique that is generally taken as the alternative to the Engle and Granger approach.

4.4.1.1 Cointegrating Regression Durbin Watson (CRDW) test

This test uses the potentially cointegrating regression Equation 4.2 and obtains the Durbin-Watson (*d*) values. These *d* values are then compared to critical values under the hypotheses that $d = 0$ or $d = 2$. If the computed *d* statistic is greater than the critical values then the series in the potentially cointegrating regression are cointegrated. The critical values are: 1% (0.511), 5% (0.386), 10% (0.322) (Gujarati, 1995: 726).

4.4.1.2 Error Correction Coefficient Significance

If potentially cointegrating series have a statistically significant error correction then it can be presumed that the two series are cointegrated (Artis and Zhang, 1998: 5). This is clearly appreciated once it is seen that cointegration and error correction systems are complementary. If a stable long run relationship exists (i.e. series are cointegrated) there must be a system to restore their equilibrium relationship in the event of a disruption. Therefore, the existence of an error correction/equilibrium restoration system is evidence that a cointegrating relationship indeed exists.

4.4.2 The Johansen Cointegration Technique

The second tool for testing for cointegration is the Johansen technique. It is based on a maximum likelihood estimation of a vector autoregressive (VAR) system. It allows for the existence of more than one cointegrating relationship in the system. Additionally, and critically, it permits testing of hypotheses about the equilibrium relationships between variables. The use of the VAR model is particularly useful in cases where the endogeneity of variables is unknown. In such cases all variables are treated as endogenous in the VAR system and then one variable is normalised on in the final determination of the cointegrating vector. By doing this the Johansen technique overcomes the simultaneous equation bias (Enders, 2004).

Additionally, it allows for not only the identification of the existence of cointegrating relationships but the number of relationships present as well. Furthermore, it allows hypothesis testing on the cointegrating relationships themselves allowing researchers to test the significance of individual variables in the cointegrating vector (Harris, 1995).

However, despite these benefits, this study does not use the Johansen technique as its cointegration framework and so it is not described in any further detail (see Section 4.4.3). A thorough explanation of the technique is available in Brooks (2008: 320-330).

4.4.3 Cointegration framework selection

This study motivates for the use of the simpler EG approach (with its two complementary tests) rather than the Johansen approach despite the growing use of the latter. This is because, firstly, in this study, the investigation will require that only two variables enter the cointegration framework (the policy determined rate and the deposit/lending rate) which means that there can be at most one stable long run relationship identified. This negates the need for the Johansen technique's ability to identify multiple cointegrating vectors. Additionally, with only two variables the need to perform hypothesis tests to establish whether a variable should be included in the cointegrating equation is similarly nullified[41].

Secondly, as the policy rates are determined by a meeting of policy makers based on monetary policy targets there should be no simultaneous relationship between policy rates and bank rates. *A priori*, we would expect that policy rates can have an effect on deposit/lending rates but that the relationship will not run in the opposite direction. Consequently, this study will not be at risk of a simultaneous equation bias. This fact negates the use of the VAR system as suggested by Johansen, in which all variables are treated as endogenous and then only later separated into endogenous and exogenous variables by normalising the coefficient value of one of the variables.

Thirdly, the comprehensive EG approach is in fact a combination of three tests for cointegration (the residual ADF test, the CRDW and error correction coefficient test) which should allow for robust conclusions as to whether cointegration exists or not.

Fourthly, as Li (2003) points out, the Johansen technique is a statistical model rather than an economic one leaving it fraught with the danger of producing dubious results. This is illustrated on two counts. The first is that it is possible to receive results indicating two cointegrating relationships in a bi-variate analysis according to both Johansen's trace and maximum

[41] If cointegration is identified then both variables are part of the cointegrating equation. It is not possible for cointegration to exist and then to discover that cointegration still exists when one of the variables is excluded. In a multiple variable case the ability to test the relevance of a particular variable in the cointegration framework may be useful but in the two variable case it is unnecessary to do so.

eigenvalues even when the maximum possible is one. The second is that it proposes a way to remove serial correlation through the lag length selection based on information criteria but fails to ensure that the results do not substitute the resolution of a statistical problem (auto-correlation) for an economic interpretability problem, as cautioned by Brooks, 2008: 157)[42]. Finally, on the point of a lack of power in small samples, the Johansen technique still suffers from the same problem as the EG approach. Ultimately while the Johansen technique is an invaluable tool in multi-variate analyses in which its ability to identify multiple cointegrating vectors, allow hypothesis testing on the cointegrating relationships and cope with situations in which the endogeneity or exogeneity of variables is unknown its benefits are not necessarily applicable in this two variable analysis.

With no need to identify more than one cointegrating relationship and no economic theory related reason to worry about the possibility of a simultaneous equation bias, this two variable investigation opts for the simpler Engle and Granger approach (complete with its two additional tests). This is in line with interest rate pass through studies around the world (c.f. Patnaik and Vasudevan (1997); Aziakpono *et al*. (2007); Wang (2008)).

Once the existence of cointegrating relationships is established an error correction framework is used to establish the short run dynamics of the relationships between the variables. This is made possible by the error correction framework that allows the disentangling of the long run co-movement of the variables from the short-run adjustment towards their equilibrium (Van Leuvensteijn *et al.*, 2008: 16).

4.5 THE ERROR CORRECTION/EQUILIBRIUM MODEL

In this study the error correction represents how much the bank lending and deposit rates adjust in a month to return to their stable long run equilibrium levels after a change in the Central Bank rate. Based on the empirical model presented in Section 4.2 the error correction model can be presented as:

$$\Delta y_t = \alpha_0 + \beta_1 \Delta x_t + \beta_2 (y_{t-1} - \gamma x_{t-1}) + \varepsilon_t \qquad (4.4)$$

[42] In a model of few variables there is a strong chance that the model will suffer from serial correlation however as cautioned by Brooks (2008, 150-161) attempting to resolve the problem requires the inclusion of additional variables which may mean that the model fails to capture the relationship it was intended to address. Much of the empirical literature similarly does not attempt to remove serial correlation in the bi-variate analysis.

Where $(y_{t-1} - \gamma x_{t-1}) = u_t$ is the error correction term which is a series of the residuals obtained form the cointegrating Equation 4.2, γ is the cointegrating coefficient whose existence means that statistical inference and OLS use is possible as stationarity concerns are negated, ε_t is a white noise error term and β_2 is the coefficient of the error correction term. If β_2 is negative and statistically significant then it can be said that market forces are in operation to restore long run equilibrium following a short run disturbance (Aziakpono *et al*, 2007). According to the Granger Representation Theorem the existence of a statistically significant error correction points to the existence of cointegration hence the use of the error correction statistic (β_2) to test for cointegration (Enders, 2004).

Once an error correction is calculated it is possible to ascertain the speed at which the bank rates adjust back to equilibrium after a change in official rates. This is done by computing mean adjustment lags which, in the context of the study, can be interpreted as indicating the speed of the IRPT.

4.6 MEAN ADJUSTMENT LAGS (MAL)

Where the error correction showed the adjustment within a month towards equilibrium the MALs show the total time taken to return to equilibrium. Following Doornik and Hendry (1994), the MAL is calculated from Equation 4.4 as follows:

$$ML = (1 - \beta_1)/\beta_2 \qquad (4.5)$$

In the case of monthly data the MAL presents how many months it takes for the change in Central Bank rates to be fully[43] reflected in bank lending and deposit rates. If the mean adjustment lag is high, then there is a high rigidity/slow adjustment in the response of bank rates to policy rate changes. The opposite would be true with a low mean adjustment lag suggesting low rigidity/fast adjustment of bank rates to policy rate changes.

These MALs are more correctly described as symmetric MALs as they reflect the response of bank rates whether they are above or below their equilibrium level. There is a way to compute the asymmetric response of bank rates to Central Bank rate changes. These asymmetric lags

[43] The word "fully" refers to the complete LR impact rather than a full reflection of the change in the Central Bank rate. I.e. if LR adjustment is only 80% then the MAL shows how long after the initial response in the bank rate does it take for the full 80% response to be reflected.

would show how long it takes bank rates to adjust up to equilibrium and down to equilibrium. These asymmetric MALs would effectively show how fast bank rates adjust upwards and downwards.

4.6.1 Asymmetric Mean Adjustment Lags

To determine the asymmetric effects Scholnik (1996) suggests the separation of the residuals (u_t) (here marked as R) from the cointegrating equation into two series R^+ and R^-, where:

$$R^+ = R, \qquad if \quad R > \mu$$

$$R^+ = 0, \qquad if \quad R < \mu$$

and

$$R^- = R, \qquad if \quad R < \mu$$

$$R^- = 0, \qquad if \quad R > \mu$$

Where μ is the mean of the error correction which is equal to zero since it is the residual series of the cointegrating equation. When a residual is above its mean it can be interpreted as the bank lending/deposit rates being above their equilibrium level with the policy rates and consequently expected to move *down* to equilibrium.

Conversely, when the residual is below its mean it can be interpreted as the bank lending/deposit rates being below their equilibrium level with policy rates and consequently expected to move back *up* to equilibrium. By splitting the residuals it is now possible to observe the speed of adjustment up or down for lending and deposit rates after Central Bank rate changes.

Once the residuals are split into two series an asymmetric error correction system is calculated from which the asymmetric MALs can be calculated. This asymmetric error correction equation is presented as follows:

$$\Delta y_t = \alpha_0 + \beta_1 \Delta x_t + \beta_2 R^+_{t-1} + \beta_3 R^-_{t-1} + u_t \qquad (4.6)$$

The relevant asymmetric mean adjustment lags become:

$$ML^+ = (1 - \beta_1)/\beta_2 \qquad (4.7)$$

and

$$ML^{-} = (1 - \beta_1)/\beta_3 \qquad (4.8)$$

The mean adjustment lags in Equations 4.7 and 4.8 show the asymmetric adjustment in bank lending and deposit rates when they are above (Equation 4.7) and below (Equation 4.8) equilibrium. If the mean lags are different then the adjustments of the bank rates can be seen to be different.

However, whether or not true asymmetry exists requires the use of the Wald test with a χ^2 (1) distribution on the restriction that Equations 4.7 and 4.8 are in fact equal[44]. If the Wald test reveals asymmetric responses when residuals are above equilibrium (and bank rates are pushed to move down) and when residuals are below equilibrium (and bank rates are pushed to move up) then it can be concluded that bank rates will adjust differently during periods of expansionary monetary policy, when bank rates are expected to rise, and contractionary monetary policy when bank rates are expected to fall.

Since the IRPT is measured by both the speed and magnitude of the adjustment of bank rates in response to Central Bank rate changes the next section describes how this study calculates the magnitude of the long run and short run adjustments and the asymmetries of those adjustments.

4.7 SYMMETRIC AND ASYMMETRIC MAGNITUDE OF ADJUSTMENT

As noted earlier, OLS estimation is spurious in cases where non-stationary series are used but is not spurious if the series are cointegrated. In cases where cointegration is found to be present the OLS estimators are actually "super consistent" allowing conventional OLS estimation to obtain the long run (LR) run impact from running a simple regression of the bank rates and the Central Bank rates (as in Equation 4.2) (Harris, 1995 and Enders, 2004)

The short run (SR) impact can be computed from running the same equation but in first differences. This equation is presented below:

[44] The Wald test works on the null that the coefficients of the asymmetric error correction terms (R^+ and R^- in Equation 4.6) are not statistically different from zero. Rejecting this null suggests that the responses of bank rates to impulses to move *down* equilibrium and *up* to equilibrium are in fact asymmetric.

$$\Delta y_t = \alpha_0 + \beta_1 \Delta x_t + u_t \quad (4.9)$$

Of importance to note here is that in cases where no cointegration is found short run adjustments can still be computed provided that the series are I(1). This is because differencing the series would leave them stationary and allow OLS estimation to produce non-spurious results. The forfeiture of long run information embedded in the data through the differencing would not be a concern in the computation of the SR parameters.

The calculation of the short run asymmetric magnitude of adjustment requires that the changes in the Central Bank rate (Δx_t) are separated into increases and decreases in the same way the residuals of the cointegrating regression were split to compute asymmetric error correction statistics from which the asymmetric MALs are computed. Following Kwapil and Scharler (2009) the SR asymmetric equation becomes:

$$\Delta y_t = \alpha_0 + \beta_1 \Delta x_t^+ + \beta_2 \Delta x_t^- + u_t \quad (4.10)$$

Where Δx_t^+ represents increases in the official rates and Δx_t^- represents decreases in the official rates. Here again asymmetry is confirmed where the Wald test on β_1 and β_2 shows that they are statistically different from zero.

The long run asymmetric response has generally not been investigated as it could not be computed in the same way as SR asymmetries because while the differencing of the series made them stationary it removed LR information embedded in the data. In this study however, in the case of the LR asymmetry we use Kwapil and Scharler (2009: 8) who provide an innovative way to compute LR asymmetries from series in 1st differences.

They propose the splitting of the changes in the bank rates (as in the SR approach above) but suggest the calculation of an Autoregressive Distributed Lag model rather than the simple expression used to compute the SR impact. This means that the following equation is calculated:

$$\Delta y_t = \alpha_0 + \sum_{i=0}^{n} \alpha_i \, \Delta x_{t-i}^+ + \sum_{q=0}^{p} \alpha_q \Delta x_{t-q}^- + \sum_{j=1}^{m} \alpha_j \, \Delta y_{t-j} \quad (4.11)$$

Where *n*, *p* and *m* denote the maximum number of lags chosen based on the Akaike Information Criterion. The asymmetric long run impact is then calculated as follows:

LR+ (LR adjustment for increase in Central Bank rates) = $(\sum_{i=0}^{n} \alpha_i) / (\sum_{j=1}^{m} \alpha_j)$ (4.12)

LR- (LR adjustment for decrease in Central Bank rates) = $(\sum_{q=0}^{p} \alpha_q) / (\sum_{j=1}^{m} \alpha_j)$ (4.13)

It should be noted that in cases where no cointegration is found the LR adjustment can still be computed from an equation such as Equation 4.11, except that in the symmetric adjustment the changes in the Central Bank rates are not split.

Once the LR and SR symmetric and asymmetric magnitude of adjustment are computed, their changes can be compared to the changes in the banking sector to investigate the possibility of a relationship between bank concentration and the size of the IRPT.

4.8 MEASURING INTEREST RATE PASS THROUGH AGAINST BANK CONCENTRATION

In order to merge the annually computed measures of banking sector concentration and the monthly data used in the IRPT analysis, this study will partially follow Demirgüç-Kunt *et al*. (2003) where an average of the level of concentration for a given period is taken and a corresponding IRPT determined. In this study, each of the four countries will have a measure of the average banking sector concentration (and its IRPT) for the entire sample period as well as average banking concentration measures for 8 year rolling windows (and their IRPTs). This means that the final analysis will be done on 32 sample periods each of at least an 8 year period complete with a measure of the IRPT as described in Sections 4.2 to 4.7 and a corresponding level of CR3 concentration. In reporting the results the results will be presented on two levels. The first will present the analysis across the countries in which the average concentration level for the entire sample period is matched to the corresponding speed and magnitude of the IRPT and the results compared between the four countries. The second is a rolling window analysis in which the changes in bank concentration are compared to their corresponding changes in the speed and magnitude of the IRPT.

Throughout the study the leading question is whether there is a distinct relationship between banking concentration changes and the strengthening/weakening of the IRPT. Once the strength/weakness of the IPRT is determined for the various periods then conclusions can be drawn as to the nature of the relationship between bank concentration and the IRPT.

If, for example, increasing levels of bank concentration are characterised by a weakening IRPT, as the Structure-Conduct-Performance hypothesis suggests, then it can be argued that a trade-off exists between bank concentration (and its benefits of easier bank regulation and insulation in financial crises) and effective monetary policy. If such a relationship does not exist then policy makers can simultaneously engage in effective monetary policy while permitting increased bank concentration.

4.9 DATA DESCRIPTION

This study uses monthly data on Central Bank/policy interest rates, average lending rates and deposit rates. It uses the annual 3 firm banking concentration ratio (CR3) in South Africa (RSA) Botswana (BOTS), Nigeria (NIG) and Zambia (ZAM) from 1994 to 2007. The countries and sample periods were selected primarily according to data availability. The data is largely sourced from the IMF International Financial Statistics (IFS) CD ROM 2009, Central Bank Reports and the New Database on Financial Development and Structure 2007 (Beck *et al*, 2007 and World Bank, 2009)

4.10 CONCLUSION

This chapter set out the empirical framework used in this study's investigation of the relationship between bank concentration and the IRPT. It outlined the importance of stationarity and the confirmatory data analysis approach to be used in this study. The different methods of cointegration were discussed and the most appropriate method for the study identified, and its use justified. The chapter then identified how the symmetric and asymmetric speeds of adjustments are calculated from an error correction framework and how the long and short run symmetric and asymmetric magnitudes of adjustments are computed. Finally it described the data used in the study and how the analysis of results is conducted. The next chapter presents the empirical results of these tests.

CHAPTER 5

EMPIRICAL RESULTS

5.1 INTRODUCTION

Having set the empirical framework and described the methods that will be used in this analysis, in this chapter we now present and discuss the empirical results. Thereafter, the conclusions and policy implications of the study are presented in Chapter 6.

As indicated in Chapter 4, the results are presented at two levels. We first present the results for the entire period for each country and compare them across the four countries. The second level presents the results for the eight year rolling windows in each country to see if changes in IRPT can be related to changes in the level of bank concentration. This chapter will be organized as follows: Section 5.2 presents stationarity and unit root test results, Section 5.3 deals with cointegration results, Section 5.4 presents symmetric error correction and asymmetric error correction results, Section 5.5 covers symmetric and asymmetric mean adjustment lag results, Section 5.6 presents symmetric and asymmetric magnitude of adjustment results and Section 5.7 concludes the empirical results. Each section will present the results on the two levels.

5.2 STATIONARITY AND UNIT ROOT TESTS

As noted in the previous chapter the two tests to be used to determine the stationarity and level of integration of the series of interest rates are the ADF and KPSS tests. These tests were conducted under both the intercept and "trend and intercept" assumptions and the results were not significantly different[45]. The results under the "trend and intercept" assumption are presented in Tables A1 to A4 of the Appendix.

5.2.1 Analysis for the entire period

In all four countries the deposit, lending and policy rates are at least stationary at first differences (I(1)) for both the ADF and KPSS tests. In some cases the series are stationary at level but this is

[45] The choice of which assumption to use was informed by visual plots of the data as suggested by Brooks (2008). However, as Table I of the Appendix shows, there is no evidence either against or in favour of a trend in each of the series. As a result the choice is not immediately apparent in the graphs. The tests were then conducted under both intercept and "intercept and trend" assumptions and both assumptions yielded similar results regarding the stationarity and level of integration of the series.

not a cause for concern as the cointegration framework used in this study requires that the underlying series are stationarity at least at first differences. Similarly, the OLS estimation of magnitude of adjustment parameters is also reliant on the variables being at least I(1).

5.2.2 Rolling Window Analysis

The results of the ADF and KPSS tests show that all the series in all the sample periods are stationary at first differences. There are periods in which the series are stationary at level but for reasons noted above this is not a cause for concern. As the series are all at least I(1) they are investigated for cointegration.

5.3 COINTEGRATION TESTS[46]

The results for the Engle and Granger ADF test, Cointegration Regression Durbin Watson test (CRDW) and the Error Correction Model coefficient test (ECM) are presented in Appendix B. The procedure in deciding if series are cointegrated when multiple tests are used follows Kremers (1992) which suggests that cointegration can be said to be present should one of the tests confirm cointegration at at least a 5% level of significance or at least two of the tests confirm cointegration at a 10% level of significance. In all the cointegration tests the test is between the deposit rates and the policy rates and the lending rates and the policy rates.

5.3.1 Analysis for the entire period

The results, presented in Table 5.1 below, show strong evidence of cointegration in South Africa and Zambia where all the tests identify cointegration at at least 5% for both lending and deposit rates. In the case of Nigeria deposit and lending rate cointegration is confirmed by only two of the tests. Botswana has the weakest evidence of cointegration for both lending and deposit rates and the cointegration is only identified by the ECM coefficient test. Particularly, noticeable in the results is that the coefficient of the ECM strongly confirms the presence of cointegration in all the countries for both lending and deposit rates at a 1% level of significance. This is significant given Artis & Zhang (1998: 5) assertion that the ECM statistic for testing cointegration can generate more powerful tests than those based on the ADF and CRDW

[46] All the cointegration tests are between the deposit rates and the bank rates and the lending rates and the bank rates.

statistics. For this reason the results still demonstrate strong evidence of cointegration even where the ECM test is the only one to confirm its presence.

TABLE. 5.1 CR3 concentration and the presence of cointegration

Conc. Rank	Conc. Level	Country	Period	Bank Rate	ADF Test	CRDW	ECM Coefficient
1	0.91	BOTS	1994-2007	Deposit	-1.819	0.137	-0.347*
	0.91	BOTS	1994-2007	Lending	-2.484	0.302	-0.353*
2	0.88	RSA	1994-2007	Deposit	-3.443**	0.498**	-0.361*
	0.88	RSA	1994-2007	Lending	-4.744*	0.793*	-0.435*
3	0.71	ZAM	1994-2007	Deposit	-3.865**	0.483**	-0.334*
	0.71	ZAM	1994-2007	Lending	-5.451*	0.920*	-0.462*
4	0.67	NIG	1994-2007	Deposit	-3.423**	0.319	-0.392*
	0.67	NIG	1994-2007	Lending	-2.948	0.448**	-0.400*

ADF McKinnon Critical values 2 variables ~ 100 observations: 1% (-4.008), 5% (-3.398), 10% (-0.3087) (Enders, 2004: 441)
ADF McKinnon Critical values 2 variables ~ 200 observations: 1% (-3.954), 5% (-3.368), 10% (-3.067) (Enders, 2004: 441)
CRDW critical values: 1% (0.511), 5% (0.386), 10% (0.322) (Gujarati, 1995: 726)
Key: Significant at 1% (*), 5% (**), 10% (***)

What is important to note is that cointegration is confirmed in all the countries regardless of the level of bank concentration. This is illustrated most clearly in Table 5.1 by the highly significant ECM coefficients in all four countries for both lending and deposit rates. This is noteworthy because cointegration is a measure of the long run relatedness of different time series, and to confirm its presence, in all the countries, despite differing levels of bank concentration, is to confirm that long run relationships can exist between policy and bank lending and deposit rates regardless of the level of bank concentration i.e. bank concentration does not appear to influence whether the series are related.

While this result cannot tell us whether bank concentration influences the strength of the relationship between the lending/deposit rates and the policy rates it does suggest that bank concentration may not be a factor in the presence of a relationship between policy and bank lending/deposit rates, and by extension the IRPT.

5.3.2 Rolling Window Analysis

In these results (see Section B of Appendix), there is cointegration for both South African deposit and lending rates in all sample periods except 2000-2007(3)[47]. In all the periods where cointegration is found the finding is robust as at least two tests confirm its presence at the 5% level. This is with the exception of the deposit rate 1999-2006 (1) where only the CRDW test confirms cointegration at 5% while the ADF test confirms it only at 10%.

In the case of Botswana, all lending rates are cointegrated with Central Bank rates. The same is not true for deposit rates where there are four periods in which deposit rates are not cointegrated with Central Bank rates 1996-2003(3), 1997-2004 (4), 1999-2006(6), 2000-2007(7). In the cases where cointegration is found it is confirmed by at least two of the three tests.

In Nigeria, in contrast to Botswana, all deposit rates are cointegrated with Central Bank rates but not all lending rates are cointegrated with policy rates. Lending rates are not cointegrated with Central Bank rates in the following periods: 1995-2002(4), 1996-2003(5), 1997-2004(6), 1998-2005(7), and 1999-2006(8). As with Botswana, where cointegration is found the results are robust and are confirmed by at least two of the tests.

Zambia is the only country in which the lending and deposit rates show evidence of stable long run relationships with the Central Bank rates in all the rolling windows. The results are also robust here and are confirmed by at least two of the tests for each period.

5.3.2.1 Cointegration vs. Bank Concentration

While the results for the individual countries are presented separately in Tables B1 to B4 in the Appendix, Table B5 presents a summary table of cointegration results for all the countries identifying which rolling window periods reveal cointegrating relationships.

One of the key revelations in the search for cointegration is that there is no distinct and consistent relationship between CR3 concentration and the existence of a stable long run relationship (cointegration) between bank rates and the Central Bank rates. For example, as

[47] In all cases the number next to the sample period denotes its level of concentration relative to the other rolling window sample periods for the country. (1) denotes the most concentrated period and (7) the least concentrated period according to the CR3 measure of concentration.

noted above, there is a lack of cointegration in the most concentrated periods in RSA while it is least concentrated periods that do not present evidence of cointegration in Botswana and Nigeria.

Additionally, comparing CR3 concentration in all the rolling windows with the presence of cointegration provides similarly ambiguous results for the relationship between bank concentration and the presence of cointegration. While it is true that in the case of deposit rates, evidence against the presence of a cointegrating relationship is found only in periods when concentration is high, the relationship is still not distinct.

The fact that there is no distinct relationship between CR3 concentration and the existence of a stable long run relationship between deposit/lending rates and Central Bank rates may be explained by considering the reasonable possibility that the existence of such cointegrating relationships would hinge on more than just the level of bank concentration. In line with empirical evidence, other factors such as the ownership of the banks, legislation and bank supervision may determine whether there is a long run relationship between policy rates and bank lending and deposit rates (c.f Allen and Gale, 2003).

What the analysis on the two levels suggests is that bank concentration may not be an influence in the relationship between bank and Central Bank rates. Put differently, whether or not bank lending/deposit rates and Central Bank rates move together appears to be independent of the level of banking sector concentration. However, more scrutiny is necessary before a comprehensive conclusion can be drawn.

Following on from the cointegration analysis this study estimates the error correction mechanism from which the speed of the adjustment of deposit and lending rates to Central Banks rate changes is calculated.

5.4 ERROR CORRECTION MODEL

5.4.1 Analysis for the entire period

The error correction results for the first level of the analysis are in Table 5.2. In each case the symmetric error correction is computed and then an asymmetric error correction is also estimated to separate the error correction mechanism between periods when bank rates are above and below equilibrium.

TABLE. 5.2 CR3 concentration and the presence of cointegration

Conc. Rank	Conc. Level	Country	Period	Bank Rate	EC_{t-1}	EC^{+}_{t-1}	EC^{-}_{t-1}
1	0.91	BOTS	1994-2007	Deposit	-0.347*	-0.891*	0.079
	0.91	BOTS	1994-2007	Lending	-0.353*	-0.272**	-0.414
2	0.88	RSA	1994-2007	Deposit	-0.361*	-0.322*	-0.419*
	0.88	RSA	1994-2007	Lending	-0.435*	0.206	-0.798*
3	0.71	ZAM	1994-2007	Deposit	-0.334*	-0.306*	-0.369*
	0.71	ZAM	1994-2007	Lending	-0.462*	-0.169	-0.663
4	0.67	NIG	1994-2007	Deposit	-0.392*	-0.726*	-0.133
	0.67	NIG	1994-2007	Lending	-0.400*	-0.536*	-0.252**

Key: Significant at 1% (*), 5% (**), 10% (***), no asterix is shown on results that are not significant
EC_{t-1} is the coefficient of the symmetric error correction; EC^{-}_{t-1} is the coefficient of the asymmetric error correction for adjustments up to equilibrium; EC^{+}_{t-1} is the coefficient of the asymmetric error correction for adjustments down to equilibrium

In all four countries symmetric error correction for both lending and deposit rates is significant as shown by the fact that all EC_{t-1} values are significant at the 1% level. In addition lending rates adjust faster than deposit rates suggesting a greater reluctance for banks to adjust deposit rates than lending rates. However, since this is true in all cases, regardless of the level of bank concentration we can see that whether or not the lending rate adjustments are faster than deposit rate adjustments is not related to the level of concentration. This result is in keeping with the intuition that since lending rates represent returns on assets (loans) and deposit rates, expenditure on liabilities (deposits), banks would adjust lending rates faster than they would deposit rates regardless of the level of concentration. In addition, it can be seen that the speed of adjustment is not related to the level of concentration. For example, Botswana with the greatest concentration has the slowest adjustment of lending rates while Nigeria has the least concentrated banking industry and the third slowest adjustment of lending rates.

In all the cases where both asymmetric results were significant for deposit rates, adjustments down were slower than deposit rate adjustments up. While this provides support for the Adverse Consumer Reaction hypothesis, the results do not provide sufficient evidence to suggest that the presence of the relationship is influenced by the level of bank concentration.

5.4.2 Rolling Window Analysis

The results for the estimated symmetric and asymmetric rolling window error correction are presented in Appendix C. As expected, in all periods in which no cointegration is identified, and the error correction is computed to perform the ECM coefficient test, there is no statistically

significant error correction both symmetrically and asymmetrically. For example, in Botswana for the periods 1999-2006 and 2000-2007 there is no evidence of cointegration and the corresponding ECM values are not significant (see Section B of Appendix). However, in so far as the symmetric adjustment is concerned there are some intuitively unappealing results in which cointegration is identified and yet the corresponding error correction is not significant. In the symmetric error correction this is the case for South Africa 1999-2006(1) Botswana's deposit rate 1998-2005(7) and lending rates 1995-2002(4), 1997-2004(6) and Zambia's deposit rate 1998-2005(7). According to Gonzalo and Lee (2000), it is possible to observe such a conflicting outcome in cases where the underlying series are fractionally integrated. In such cases the series are not actually I(1) as identified by the stationarity/unit root tests. Consequently, the cointegration results on such series are in fact spurious. In all cases, however, there is no pattern between the changes in the bank concentration and the size or significance of the symmetric error correction.

In terms of the asymmetric error correction, there are fewer periods in which both the asymmetric error correction terms are significant than periods in which at least one of them is not significant (see Tables C1 to C4). Neither in the size nor significance of the positive (EC^{+}_{t-1}) and negative error correction (EC^{-}_{t-1}) is there a clear relationship between bank concentration and the error correction mechanism of the cointegrated series.

However, as noted in Chapter 4, the study computes mean adjustment lags to assess how long the adjustment to equilibrium takes in cases where the error correction is significant. Moreover, the Wald[48] test results (attached to the mean adjustment lag results in Tables D-1 to D-4) suggest that where both the positive and negative asymmetric error corrections are significant there is support for the hypothesis that they are statistically different. However, as can be seen in the tables, the presence or lack of asymmetry is not related to the level of bank concentration. This is clear where South Africa and Zambia have significant lending rate asymmetry in their most concentrated and least concentrated periods. Similarly, in Botswana and Nigeria in the few cases in which the asymmetric error corrections are significant, there is not a pattern between the presence of asymmetry and the level of bank concentration. This all suggests that whether or not

[48] Since each asymmetric error correction term has a corresponding asymmetric MAL, finding evidence of asymmetry in the error correction is to find asymmetry in the corresponding MAL.

the speed of adjustment of deposit and lending rates is characterised by asymmetry in adjustments up and down is not related to the level of bank concentration.

5.5 MEAN ADJUSTMENT LAGS[49]

While the error correction coefficients show by how much bank rates adjust back to equilibrium in each month, they do not show how long the complete adjustment will take. To determine the speed of the adjustment of the bank rates to Central Bank rate changes the study computes the mean adjustment lags as described in the Chapter 4. The full results are presented in Section D of the Appendix.

5.5.1 Analysis for the entire period

In this analysis the study compares the symmetric mean adjustment and asymmetric mean adjustment to the average level of concentration in each of the four countries over the entire sample period as presented in Table 5.3.

TABLE. 5.3 CR3 concentration and speed of adjustments across the countries

Conc. Rank	Conc. Level	Country	Period	Bank Rate	MAL	MAL+	MAL-
1	0.91	BOTS	1994-2007	Deposit	2.594	0.961	-
	0.91	BOTS	1994-2007	Lending	1.665	2.175	1.428
2	0.88	RSA	1994-2007	Deposit	0.633	0.708	0.545
	0.88	RSA	1994-2007	Lending	0.413	-	0.263
3	0.71	ZAM	1994-2007	Deposit	0.700	0.765	0.635
	0.71	ZAM	1994-2007	Lending	0.492	-	-
4	0.67	NIG	1994-2007	Deposit	1.380	0.751	-
	0.67	NIG	1994-2007	Lending	0.732	0.548	1.168

MAL: Symmetric Mean Adjustment Lag
MAL+: Mean Adjustment Lag when the bank rate is above its equilibrium with the official rate and the impulse is for bank rates to fall
MAL-: Mean Adjustment Lag when the bank rate is below its equilibrium with the official rate and the impulse is for bank rates to rise
*Only the MAL of significant error corrections are reported in this table (for full set of results see Appendix Tables C1 to C4 and D1 to D4)

As can be seen in Table 5.3 above, Botswana has the highest level of concentration and the largest symmetric MAL/slowest adjustment for both deposit and lending rates. After a shock to the equilibrium relationship it takes on average 2.6 months (approximately 78 days) and 1.7 months (approximately 50 days) for deposit rates and lending rates to return to equilibrium. It follows that for a discernable relationship to be seen between bank concentration and the speed

of adjustment, the country with the lowest concentration must have the fastest symmetric adjustment/lowest MAL. However, despite having the lowest level of concentration Nigeria does not have the smallest MALs. The fastest adjustment for both deposit and lending rates occurs in South Africa where despite having the second highest level of concentration it takes 0.7 months (approximately 19 days) and 0.5 months (approximately 13 days) for deposit rates and lending rates to return to equilibrium. This analysis does not show a relationship between the level of concentration and the symmetric adjustment of bank lending/deposit rates to Central Bank rate changes.

In the case of the asymmetric adjustment, there is a negative relationship between the adjustment down to equilibrium in lending rates and the level of banking concentration. Botswana, with the most concentrated banking sector, has the slowest adjustment of lending rates followed by Zambia and then Nigeria, which has the least concentrated banking sector. This suggests that the more concentrated the banking industry the slower the speed in the reduction of lending rates back to equilibrium. This is evidence in support of the Structure Conduct Hypothesis which suggests that concentrated markets are susceptible to collusion which would slow down profit reducing reductions in lending rates. This evidence supports the findings of Corvoisier and Gropp (2002) which also identify evidence in support of the SCP in the banking industries of EU countries. However, some caution is necessary in drawing conclusions on these results as this relationship exists in the absence of a significant MAL+ for South Africa, which had the fastest symmetric adjustment.

The downward adjustment of deposits (MAL+) and the upward adjustment of both lending and deposit rates (MAL-) do not show a relationship between bank concentration and the speed of adjustment. This is illustrated in Table 5.3 by the fact the increasing bank concentration is not associated with either an increase or decrease in the mean adjustment lags. Using the Wald test, the null hypothesis that there is no asymmetry is rejected in all the countries for both lending and deposit rates (see Appendix Tables D1 to D4). As a result it can be seen that asymmetry exists between the response of bank rates to impulses to rise or fall to equilibrium. However, since the asymmetry is present in all the countries it is, at least according to the first level of analysis, not related to the level of bank concentration.

5.5.2 Rolling Window Analysis[50]

As shown in Table D1, South Africa does not present evidence of a clear relationship between changing bank concentration and either a slower or faster symmetric speed of adjustment. For the same reason as the analysis of the entire period, no relationship is observable as increasing bank concentration is not clearly associated with increases or decreases in the mean adjustment lags[51]. The result is the same for adjustments up to equilibrium (MAL+) and adjustments down to equilibrium (MAL-). However, as may be expected, the impulses for profit boosting increases in lending rates are faster than the impulses to reduce them. Of interest in the case of South Africa is that deposit rates adjust faster to impulses to increase than decrease providing support for the adverse consumer reaction hypothesis. However, again, while some support for this theory may exist, there is still no evidence of a relationship between both the symmetric and asymmetric speed of adjustment and the level of bank concentration.

In Botswana the symmetric adjustments are larger than in South Africa suggesting that both lending and deposit rates adjusted more slowly in Botswana than in South Africa (with the lower concentration of the two). However, Nigeria with the lowest concentration has slower adjustments than more concentrated South Africa and Zambia which quashes the possibility of a relationship. However, within Botswana there is an indication that bank concentration is negatively related to the speed of adjustment of deposit rates symmetrically and when they are above equilibrium (and the impulse is for them to fall). This relationship is identifiable in the three most concentrated periods where the reduction in concentration is associated with slower symmetric and negative adjustments of deposit rates. The relationship between the asymmetric response and the level of bank concentration is not observable as the asymmetric mean adjustment lags are not significant in the same periods for MAL+ and MAL- for both lending and deposit rates except in one period.

The results for Nigeria, in Table D3, also show some signs of a relationship. As with Botswana there is a relationship but in this case it is a positive relationship in the deposit rate between decreasing bank concentration and a slower speed of adjustment in the least concentrated periods

[50] See Section D of Appendix.
[51] If increasing bank concentration was associated with either larger or smaller MALs then it would be clear that a pattern/relationship is present between bank concentration and the speed of the IRPT, as represented by the MALs.

for symmetric deposit rates while there is a negative relationship over the same period for falling concentration and the faster adjustment of increasing deposit rates. The symmetric and asymmetric response of lending rates in Nigeria is not related to the level of bank concentration.

In Zambia bank concentration is negatively related to the symmetric and asymmetric mean adjustment lags for deposit rates in the most concentrated periods. As concentration fell the time taken for deposit rates to return to equilibrium increased i.e. the speed of adjustment fell. This is a similar relationship to the one identified in Botswana. However, as with Botswana, the relationship does not hold for all the periods and so cannot be described as a distinct relationship. In terms of the lending rates, as with the other countries in the study a clear relationship could not be identified.

Where the Wald test was performed to determine whether MAL+ was truly different from MAL- the results suggested that there was asymmetry in the response of bank rates to impulses to rise or fall to equilibrium with official rates. As in the analysis for the entire period, the presence of asymmetry was not related to the level of banking sector concentration (see Tables D1 to D4 of the Appendix).

The analysis of results identified traces of a relationship between bank concentration and the symmetric and negative adjustment of deposit rates and falling lending rates, and moves onto an investigation of the relationship between bank concentration and the magnitude of the adjustment of bank rates in the short and long run, symmetrically and asymmetrically in response to official rate changes.

5.6 MAGNITUDE OF ADJUSTMENT

The magnitude of adjustment refers to the size of the change in the bank lending and deposit rates following a change in Central Bank rates. The results, computed following the procedure laid out in Chapter 4, are presented below.

5.6.1 Analysis for the entire period

As presented in Table 5.4 below, the short run symmetric adjustment in deposit rates following a change in official rates is smallest in Nigeria where concentration is smallest. It is at its largest in

South Africa where concentration is highest[52]. Based on this, the size of the short run adjustment of deposit rates is positively related to bank concentration. This is to say that the greater the concentration, the larger the size of the adjustment. However, the symmetric adjustment of lending rates does not show a similar pattern as the inclusion of Botswana (with the smallest adjustment) means that no clear relationship can be seen between concentration and the size of lending rate adjustments.

TABLE 5.4 Cross-country comparison of CR3 conc. and magnitude adjustments

Conc. Rank	Conc. Level	Country	Period	Bank Rate	SR	SR+	SR-	LR	LR+	LR-
	0.91	BOTS	1994-2007	Deposit	-	-	0.374	0.3	0.271	0.923
1	0.91	BOTS	1994-2007	Lending	0.36	0.295	0.446	0.98	0.773	0.797
	0.88	RSA	1994-2007	Deposit	0.72	0.719	0.722	0.92	1.005	1.047
2	0.88	RSA	1994-2007	Lending	0.826	0.806	0.852	0.98	1.101	0.949
	0.71	ZAM	1994-2007	Deposit	0.716	0.733	0.699	0.86	0.837	0.923
3	0.71	ZAM	1994-2007	Lending	0.985	0.771	0.714	0.92	1.1	0.954
	0.67	NIG	1994-2007	Deposit	0.482	0.429	0.7	0.92	0.726	0.612
4	0.67	NIG	1994-2007	Lending	0.701	-	0.989	0.99	0.465	1.088

Only statistically significant parameters are reported here. Full tables are in the Appendix Tables E1 to E8.
SR refers to the proportion of the policy rate change that is reflected in the bank rates in the short run,
SR+ refers to the proportion of a positive policy rate change that is reflected in the bank rates in the short run,
SR- refers to the proportion of a negative policy rate change that is reflected in the bank rates in the short run.
LR refers to the proportion of the policy rate change that is reflected in the bank rates in the long run,
LR+ refers to the proportion of a positive policy rate change that is reflected in the bank rates in the long run,
LR- refers to the proportion of a negative policy rate change that is reflected in the bank rates in the long run.

In-so-far-as the SR asymmetric response is concerned the Wald test confirms the presence of asymmetry in all the countries regardless of the level of concentration (see Tables F1 to F4 in Appendix).

Table 5.4 also presents the long run symmetric and asymmetric magnitudes of adjustment. As can be seen, there is no clear pattern between concentration and the symmetric magnitude of adjustment of lending and deposit rates. In the case of lending rates, while Nigeria has the smallest long run adjustment and the lowest level of concentration, the largest adjustment is not associated with the most concentrated country (Botswana).

The symmetric long run adjustment results are in line with the findings of the short run results where no clear pattern can be seen between bank concentration and either a rising or falling size

[52] Botswana is eliminated from the analysis as it does not have a statistically significant value for the short run adjustment. This leaves South Africa as the most concentrated country in-so-far-as the symmetric short run adjustment is concerned.

of adjustment following a positive or negative change in official rates. However, unlike the case of the short run adjustments, the Wald test shows that the response is only asymmetric for lending rates in Zambia and Nigeria and deposit rates in Zambia (countries with the lowest level of concentration). This indicates that asymmetry in the long run adjustment of bank rates may be related to the level of banking sector concentration. The rolling window analysis below should provide clearer evidence if this is in fact the case.

5.6.2 Rolling Cointegration Analysis[53]

In South Africa the symmetric adjustment of long run lending and deposit rates is negatively related to the level of banking sector concentration in the rolling windows from 1994-2001 to 1999-2006 (lending rates) and 1995-2002 to 1999-2006 (deposit rates). Increasing concentration is associated with lower long run adjustments in bank rates following changes in official rates. This is in keeping with the SCP that suggests collusive behaviour will hinder the full reflection of changes in official rates in bank rates.

In Botswana the only sign of a relationship between the symmetric long run adjustment and bank rate adjustment can be seen in lending rates in the rolling windows 1994-2001 to 1996-2003 where falling concentration is associated with larger long run adjustments. This is a similar relationship to the one found in South Africa and it provides additional support for the influence of the SCP in so far as symmetric lending rate adjustments are concerned (see Table E6). As Table E7 shows, results on Nigeria do not give any evidence of a relationship between concentration and the symmetric adjustment of both lending and deposit rates. In contrast the evidence from Zambia (in Table E8) is similar to the findings in Botswana and South Africa where a relationship can be seen between falling concentration and larger symmetric magnitude of adjustments for lending rates.

In-so-far-as the relationship between the level of concentration and the asymmetric response of the long run magnitude of adjustment is concerned, there is some evidence of a relationship with the positive long run adjustment and none with the negative long run adjustment. As Table E5 shows, falling concentration is associated with larger long run adjustments in deposit rates

[53] See Section E of Appendix.

following both increases (LR+) and decreases (LR-) in the official rate. The results for lending rates do not depict any relationship.

In Botswana the only evidence of a relationship between the asymmetric adjustments and the level of concentration is in the lending rates. Over the sample period a falling level of bank concentration is associated with a larger long run positive adjustment in lending rates following a positive change in the official rate (see Table E6). In Nigeria there is evidence that both lending and deposit rates' positive long run adjustments are related to the level of banking sector concentration. In the rolling windows 1996-2003 to 1999-2006 decreases in the level of concentration were associated with increases in the size of the positive long run adjustment of deposit rates while in the rolling windows 1994-2001 and 1995-2002 falling concentration is associated with a decreasing size in the positive long run adjustment of lending rates. In Zambia the positive long run adjustment of lending rates is positively related to the level of concentration. As the concentration level falls the size of the positive long run adjustment also falls.

Of particular importance is that in all four countries whether the size of the negative adjustment is smaller or bigger than the corresponding positive adjustment for deposit and lending rates is not related to the level of banking sector concentration (see Tables E5 to E8).

As to the question of whether the presence of asymmetry is contingent on bank concentration, there is no evidence that there is such a relationship as shown in the Wald test results in Tables E5 to E6 in the Appendix. These show evidence rejecting the null hypothesis of no asymmetry is weak and so in the majority of cases no asymmetry is found in the long run adjustments. Where asymmetry is found it is not contingent on the corresponding level of bank concentration. Put differently, the presence of asymmetry does not vary with the level of banking sector concentration.

5.7 CONCLUSION

This chapter provided evidence of relationships between bank concentration and the speed and magnitude of IRPT. While the relationships were not always distinct they were often confirmed in more than one country, giving the result greater credibility. What was clear though was that there was no evidence that asymmetry in the speed or magnitude of the IRPT was related to the

level of bank concentration. However, despite presenting the results of the empirical analysis, this chapter did not provide the policy implications of those results as that analysis is reserved for Chapter 6. It did reveal an important fact that the conclusions that could be drawn from the analysis of the entire period for the four countries often contradicted the evidence from the rolling window analysis. For example, where the analysis of the entire period could not identify a relationship between bank concentration and the IRPT, the rolling window analysis did. This is possibly a reason for disagreement in the empirical evidence as the conclusion based on the two levels of analysis was sometimes different[54].

With the empirical results presented the next chapter presents the conclusions of this study, the policy implications of the results and areas for future study.

[54] This can be illustrated by Cottarelli and Kourellis (1994) who conduct and analysis of 63 countries and conclude that there is no relationship while studies like Corvoisier and Gropp (2002) do.

CHAPTER 6:

SUMMARY, CONCLUSIONS, IMPLICATIONS OF RESULTS, AND AREAS FOR FURTHER STUDY

6.1 SUMMARY AND CONCLUSIONS

This study set out to investigate the relationship between bank concentration and the IRPT in four African countries. Such an investigation in the African context was important not only because research in the area was scant by US and EU levels, but also because the review of theoretical and empirical literature did not arrive at a consensus on whether a relationship existed and, where one was found, what the nature of that relationship was. Following the inconclusive results of the literature review the study set six key objectives. The first was to determine whether there was a relationship between bank concentration and the speed of the IRPT. The second was to determine whether a relationship could be found between bank concentration and the magnitude of the IRPT. The third and fourth objectives were to determine whether changes in the symmetric and asymmetric speed and magnitudes of the IRPT were related to the level of bank concentration. The fifth objective was to assess whether changes in bank concentration, over time, were related to the speed and magnitude of the IRPT. The final objective was to articulate the policy implications of the empirical results of the study.

The theoretical literature review presented two competing theories on the possibility and nature of a relationship between bank concentration and the IRPT. The Structure Conduct Performance Hypothesis suggested increased bank concentration would lead to collusive bank behaviour and a weakening of the IRPT's speed and magnitude. The Efficient Market Hypothesis, in contrast, suggested that increasing bank concentration arose from market efficiency and that any attempt by banks to retard the IRPT, by resisting monetary policy impulses, would be quickly quashed. In addition to this contention in the industrial organisation theory, some research suggested that no relationship actually existed between bank concentration and the IRPT and that any semblance of a relationship captured the relationship between banking sector *competition* and the IRPT. Furthermore, these researchers suggested that given that concentration and competition are not necessarily synonymous, the expectation that concentration would be related to the IRPT

was questionable. The lack of clarity in the theoretical literature was compounded by empirical literature that similarly provided conflicting conclusions on whether a relationship existed.

Given the lack of consensus in literature and the growth in mergers, acquisitions and consolidation exercises in the banking industries around the world (and in particular in Africa), this study was undertaken. Using Symmetric and Asymmetric Error Correction Models, Mean Adjustment Lags, Ordinary Least Squares estimations and Autoregressive Distributed Lag models, as described in Chapter 4, the study identified the following:

Regarding the speed of adjustment, there is evidence that in some cases, bank concentration is related to the speed of the IRPT. In the analysis of the entire period there is evidence of a negative relationship between bank concentration and speed of lending rate adjustments down to equilibrium suggesting that the greater the concentration, the slower the reduction in lending rates by banks following a change in official rates. Put differently, bank concentration can be seen to negatively impede expansionary monetary policy when lending rates are expected to fall. However, once the analysis is moved to the rolling windows, the trend over time suggests a relationship only in the adjustment of deposit rates. In addition, where the trend over time shows a relationship between bank concentration and the symmetric and negative adjustment of deposit rates, the nature of the relationship is not consistent. In Botswana and Zambia the relationship is a negative one suggesting that greater bank concentration results in slower adjustments of deposit rates while in Nigeria it is a positive one suggesting that greater bank concentration is associated with faster adjustments in deposit rates. In addition the evidence from the Wald tests shows that bank concentration is not related to the presence of asymmetry in the speed of adjustment of both lending and deposit rates. This result is the same for the analysis of the entire period and the analysis through the rolling windows.

In-so-far-as the magnitude of the adjustment is concerned, there is more evidence to suggest a relationship with bank concentration than there is to suggest a relationship between bank concentration and the speed of the IRPT. There is a positive relationship between the symmetric adjustment of deposit rates and the level of bank concentration in the analysis of the entire period. This analysis also shows a relationship between falling concentration and larger long run negative adjustments in lending rates which suggest that the responsiveness of banks to monetary policy impulses to reduce lending rates is negatively affected by bank concentration. In other

words, bank concentration stifles the magnitude of the IRPT and by implication the effectiveness of monetary policy. In the rolling window analysis the evidence suggests a relationship with deposit rates as well. However, in some cases the relationships are positive while in others they are negative suggesting that there is no consistent relationship between bank concentration and the magnitude of the IRPT in both the short run and long run, symmetrically or asymmetrically. In some cases there is evidence that supports the Structure Conduct Performance hypothesis while in others there is evidence supporting the Efficient Market Hypothesis.

It is important to note that the relationships were not consistent between the countries and across the two levels of analysis. This suggests that the relationships were either not the natural outcome of bank concentration and the IRPT (supporting researchers such as Van Leuvensteijn, *et al*, 2008) or that there are some mitigating factors that are preventing the observation of the relationship. While the true explanation may still be debated, what is clear in the evidence is that bank concentration is not consistently related to the speed and magnitude of the IRPT. As a result, while the results show that bank concentration can be negatively and positively related to the speed and magnitude of the IRPT it should not be expected that greater concentration will either automatically retard or accelerate the IRPT and make monetary policy transmission any more or any less effective. Additionally, the fact that the relationships observed between bank concentration and the IRPT cannot be captured neatly by one hypothesis suggests that the influence of bank concentration will not be universal but will capture the trend within a country at the time. Consequently, trying to identify a single relationship will continue to provide inconclusive results where the reality is that bank concentration can be related to the IRPT in different ways in different countries at different times.

The fact that the monetary policy has generally been effective in the sample countries (see Chapter 3) seems to suggest that the question for effective monetary policy transmission should not be one of whether bank concentration is related to the IRPT but that given the relationship that is identified by researchers at the time, how policy rates can be set to ensure sufficient and timely reflection in lending and deposit rates to achieve effective monetary policy.

6.2 POLICY IMPLICATIONS OF RESULTS

The most important implication of these results is that the African trend towards bank consolidation (in line with the global trend noted earlier) is not to be immediately regarded with alarm in-so-far-as effective monetary policy is concerned. Simply because concentration is likely to increase is not to say that the IRPT will weaken or monetary policy will be less effective.

Another important outcome of the study is that the analyses on different levels produced different results and these results were not mirrored by the simple trend analyses of Chapter 3. The analysis of the four countries for the entire period produced results that were contradicted by the rolling window analysis that captured the trend over time. This suggests an explanation for variations in empirical evidence as the investigation of the same data set in this study produced conflicting results. For this reason some caution is necessary in the interpretation of any empirical results on the analysis of the IRPT.

It is important to note that this study is not a vindication of proponents of increased bank consolidation and concentration. Such a conclusion can only be informed in part by this study because there are still other concerns around the operation of highly concentrated markets, for example, the potential abuse of market power access to financial capital.

As competition commissions consider legislation relating to policy on acceptable mergers, acquisitions and consolidation exercises in the banking industry they may now do so informed of the fact that the evidence in the selected African countries in this study is that the level of banking concentration can be, but is not always, related to the either the strength or weakness of the IRPT of policy changes to bank deposit and lending rates.

6.3 AREAS FOR FURTHER STUDY

This study's greatest challenge was data availability. In the event that bank level data is obtained, it is possible that the results of a similar analysis may reveal that concentration is related to the IRPT only in specific products. In other words, bank concentration may be positively related to a slower IRPT of policy rate changes to corporate loans while a relationship may not be present for bank overdrafts. In this case simply concluding that the IRPT of policy rate changes to lending

rate changes is not related to the level of bank concentration would ignore the product level differences.

Additionally, the availability of firm level data on market shares for all banks in all years for all countries may allow the study to be repeated with different measures of concentration (like the HHI) to assess whether the conclusions reached are the result of the measure of concentration are a true reflection of the relationship between bank concentration and the speed and magnitude of the IRPT.

Furthermore, this study did not explicitly investigate causality between bank concentration and the speed and magnitude of the IRPT but, rather, whether differences in bank concentration could help explain differences in the IRPT in four African countries. With more data points for bank concentration, causality could be investigated. For example, with the use of more frequent bank concentration data points rather than the annual ones available to this study, granger causality could be investigated by determining if changes in bank concentration actually precede the changes in the speed and magnitude of the IRPT. However, despite these limitations, the conclusions and observations made in this study are relevant for public policy consideration because they provide insight on an important issue surrounding bank market structure, monetary policy and, ultimately, economic performance.

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APPENDIX
STATISTICAL AND MODEL FITTING RESULTS

KEY:
Significance denoted at 1%, 5%, 10% by (*),(**),(***), respectively
Unless otherwise stated all tables and figures are calculated by the author from the data set.

SECTION A: STATIONARITY and UNIT ROOT TESTS

ADF (H: 0 ~ Unit Root) Critical Values: 1% (-3.464643), 5% (-2.876515), 10% (-2.574831)
KPSS (H: 0 ~ Stationarity) Critical Values: 1% (0.739), 5% (0.463), 10% (0.347)

TABLE A1: RSA (Stationarity/Unit Root Test)

	DEPOSIT RATE				LENDING RATE				POLICY RATE			
	ADF		KPSS		ADF		KPSS		ADF		KPSS	
	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff
1994-2001	-1.944	-4.724*	0.442*	0.212*	-1.405	-6.349*	0.374*	0.260*	-1.388	-5.951*	0.343*	0.278*
1995-2002	-2.011	-4.924*	0.738	0.117*	-1.623	-6.671*	0.640*	0.126*	-1.64	-6.299*	0.621*	0.621*
1996-2003	-1.676	-7.017*	0.875	0.095*	-1.595	-4.361*	0.812	0.108*	-1.048	-6.123*	0.834	0.118*
1997-2004	-1.392	-7.037*	0.913	0.050*	-1.745	-4.156*	0.882	0.056*	-1.235	-6.072*	0.939	0.055*
1998-2005	-1.557	-6.972*	0.848	0.053*	-1.368	-4.437*	0.859	0.053*	-1.458	-3.848*	0.927	0.051*
1999-2006	-2.541	-6.011*	0.851	0.323*	-1.974	-3.231*	0.887	0.285*	-1.965	-3.236**	0.982	0.266*
2000-2007	-1.304	-6.014*	0.463*	0.221*	-2.206	-2.644*	0.582*	0.164*	-2.177	-2.733***	0.699*	0.170*
1994-2007	**-1.883**	**-6.360***	**1.047**	**0.110***	**-1.849**	**-5.862***	**1.029**	**0.108***	**-1.421**	**-2.921****	**1.058**	**0.107***

TABLE A2 BOTSWANA (Stationarity/Unit Root Test)

	DEPOSIT RATE				LENDING RATE				POLICY RATE			
	ADF		KPSS		ADF		KPSS		ADF		KPSS	
	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff
1994-2001	-2.078	-7.294*	0.423*	0.252*	-0.941	-10.079*	0.759	0.130*	-1.474	-14.232*	0.366*	0.149*
1995-2002	-3.511*	-14.929*	0.390*	0.219*	0.287	-8.187*	0.955	0.218*	-0.552	-12.669*	0.711*	0.403*
1996-2003	-1.517	-9.124*	0.571*	0.103*	-0.823	-8.563*	1.073	0.151*	-1.041	-13.142*	1.083	0.115*
1997-2004	-1.649	-9.592*	0.719	0.077*	-1.218	-8.919*	1.051	0.170*	-1.397	-13.365*	1.066	0.127*
1998-2005	-1.659	-10.316*	0.549*	0.120*	-2.547	-9.295*	0.846	0.407*	-2.53	-13.544*	0.863	0.236*
1999-2006	-1.778	-10.258*	0.330*	0.275*	-2.547	-9.585*	0.640*	0.212*	-1.984	-14.028*	0.641*	0.086*
2000-2007	-1.28	-10.240*	0.774	0.214*	-2.177	-8.924*	0.319*	0.129*	-3.289**	-13.960*	0.349*	0.060*
1994-2007	**-1.924**	**-8.013***	**0.713**	**0.313***	**-2.59*****	**-14.135***	**1.417**	**0.129***	**-2.80*****	**-16.164***	**0.807**	**0.083***

TABLE A3 NIGERIA (Stationarity/Unit Root Test)

	DEPOSIT RATE				LENDING RATE				POLICY RATE			
	ADF		KPSS		ADF		KPSS		ADF		KPSS	
	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff
1994-2001	-2.116	-4.860*	0.211*	0.179*	0.114	-11.464*	0.499*	0.593*	-0.602	-4.081*	0.856	0.115*
1995-2002	-2.667	-5.464*	0.428*	0.089*	-1.464	-9.591*	0.815	0.115*	-1.317	-7.305*	0.911	0.078*
1996-2003	-1.882	-12.294*	0.631*	0.103*	-1.466	-9.708*	0.739	0.165*	-1.438	-7.972*	0.643*	0.133*
1997-2004	-1.924	-13.056*	0.753	0.099*	-1.458	-9.977*	0.484*	0.211*	-1.549	-7.972*	0.304*	0.145*
1998-2005	-1.601	-13.335*	0.256*	0.236*	-1.36	-9.188*	0.299*	0.376*	-1.292	-8.099*	0.295*	0.212*
1999-2006	-1.592	-13.312*	0.350*	0.100*	-0.979	-8.469*	0.666*	0.324*	-0.625	-7.316*	0.857	0.252*
2000-2007	-1.313	-13.805*	0.568*	0.086*	-0.698	-9.015*	0.983	0.149*	-0.627	-9.811*	0.999	0.104*
1994-2007	**-2.403**	**-17.491***	**0.424***	**0.045***	**-2.113**	**-16.950***	**0.547***	**0.079***	**-1.96**	**-13.322***	**0.379***	**0.056***

TABLE A4 ZAMBIA (Stationarity/Unit Root Test)

	DEPOSIT RATE				LENDING RATE				POLICY RATE			
	ADF		KPSS		ADF		KPSS		ADF		KPSS	
	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff	Level	1st Diff
1994-2001	-1.098	-7.764*	0.365*	0.130*	-2.036	-6.468*	0.457*	0.130*	-1.942	-6.118*	0.469*	0.143*
1995-2002	-2.029	-4.782*	0.244*	0.155*	-1.712	-6.511*	0.266*	0.161*	-1.852	-5.932*	0.287*	0.147*
1996-2003	-1.454	-5.014*	0.624*	0.221*	-2.206	-2.944*	0.499*	0.376*	-2.177	-2.933***	0.699*	0.133*
1997-2004	-2.515	-11.202*	0.843	0.232*	-1.362	-10.410*	0.277*	0.190*	-2.482	-12.024*	0.427*	0.296*
1998-2005	-1.814	-4.342*	0.775	0.081*	-2.263	-12.165*	0.700*	0.071*	-1.818	-9.224*	0.342*	0.087*
1999-2006	-2.968	-11.610*	0.629*	0.096*	-2.541	-12.369*	0.537*	0.078*	-2.148	-9.137*	0.254*	0.128*
2000-2007	-0.97	-10.842*	1.006	0.085*	-3.507*	-10.200*	0.189*	0.149*	-2.239	-9.186*	0.696*	0.167*
1994-2007	**-2.633**	**-8.235***	**0.753**	**0.214***	**-2.315**	**-9.356***	**0.450***	**0.156***	**-2.147**	**-11.326***	**0.452***	**0.112***

SECTION B: COINTEGRATION ANALYSIS

ADF McKinnon Critical values 2 variables ~ 100 observations: 1% (-4.008), 5% (-3.398), 10% (-0.3087) (Enders, 2004: 441)
ADF McKinnon Critical values 2 variables ~ 200 observations: 1% (-3.954), 5% (-3.368), 10% (-3.067) (Enders, 2004: 441)
CRDW critical values: 1% (0.511), 5% (0.386), 10% (0.322) (Gujarati, 1995: 726)
Conc. Rank is the 3 firm concentration ratio ranking of rolling windows with 1 being the most concentrated and 7 the least concentrated.

TABLE B1			**Engle and Granger Model**			
			ADF	**CRDW**	**ECM coefficient**	*ECM (prob).*
Conc. Rank		**Dep. Variable**				
	SOUTH AFRICA					
7	1994-2001	Deposit Rate	-2.594	0.586*	-0.407	0.000
6	1995-2002	Deposit Rate	-2.936	0.594*	-0.497	0.000
5	1996-2003	Deposit Rate	-4.339*	0.658*	-0.379	0.000
4	1997-2004	Deposit Rate	-4.883*	0.755*	-0.399	0.000
2	1998-2005	Deposit Rate	-5.187*	0.880*	-0.392	0.000
1	1999-2006	Deposit Rate	-3.309***	0.444**	-0.113	0.330
3	2000-2007	Deposit Rate	-2.548	0.239	-0.055	0.569
	1994-2007	**Deposit Rate**	**-3.443****	**0.498****	**-0.361**	**0.000**
7	1994-2001	Lending Rate	-5.389*	0.952*	-0.496	0.000
6	1995-2002	Lending Rate	-5.198*	0.897*	-0.581	0.000
5	1996-2003	Lending Rate	-4.890*	0.811*	-0.446	0.000
4	1997-2004	Lending Rate	-4.891*	0.813*	-0.505	0.000
2	1998-2005	Lending Rate	-3.487**	0.802*	-0.500	0.000
1	1999-2006	Lending Rate	-2.061	0.402**	0.607	0.000
3	2000-2007	Lending Rate	-1.745	0.101	-0.034	0.512
	1994-2007	**Lending Rate**	**-4.744***	**0.793***	**-0.435**	**0.000**

TABLE B2			**Engle and Granger Model**			
			ADF	**CRDW**	**ECM coefficient**	*ECM (prob).*
Conc. Rank		**Dep. Variable**				
	BOTSWANA					
1	1994-2001	Deposit Rate	-2.739	0.905*	-0.408	0.000
2	1995-2002	Deposit Rate	-5.48*	0.969*	-0.351	0.000
3	1996-2003	Deposit Rate	-2.647	0.281	-0.013	0.907
4	1997-2004	Deposit Rate	-3.250	0.367***	-0.050	0.642
5	1998-2005	Deposit Rate	-3.945**	0.503**	-0.039	0.717
6	1999-2006	Deposit Rate	-1.674	0.172	-0.082	0.432
7	2000-2007	Deposit Rate	-1.284	0.106	-0.100	0.347
	1994-2007	**Deposit Rate**	**-1.819**	**0.137**	**-0.347**	**0.000**
1	1994-2001	Lending Rate	-2.154	0.431**	-0.239	0.004
2	1995-2002	Lending Rate	-4.543*	0.558*	-0.152	0.110
3	1996-2003	Lending Rate	-9.353*	1.927*	-0.257	0.026
4	1997-2004	Lending Rate	-9.343*	1.925*	0.011	0.887
5	1998-2005	Lending Rate	-9.415*	1.908*	-0.267	0.014
6	1999-2006	Lending Rate	-9.915*	1.768*	-0.234	0.038
7	2000-2007	Lending Rate	-8.965*	1.824*	-0.505	0.000
	1994-2007	**Lending Rate**	**-2.484**	**0.302**	**-0.353**	**0.000**

TABLE B3			**Engle and Granger Model**			
			ADF	**CRDW**	**ECM coefficient**	*ECM (prob).*
Conc. Rank		**Dep. Variable**				
	NIGERIA					
1	1994-2001	Deposit Rate	-2.132	0.214	-0.241	0.020
2	1995-2002	Deposit Rate	-2.065	0.267	-0.308	0.005
3	1996-2003	Deposit Rate	-2.402	0.376***	-0.330	0.002
4	1997-2004	Deposit Rate	-2.471	0.427**	-0.313	0.003
5	1998-2005	Deposit Rate	-2.504	0.494**	-0.443	0.000
6	1999-2006	Deposit Rate	-2.589	0.501**	-0.447	0.000
7	2000-2007	Deposit Rate	-2.528	0.489**	-0.428	0.000
	1994-2007	**Deposit Rate**	**-3.4****	**0.319**	**-0.392**	**0.000**
1	1994-2001	Lending Rate	-1.641	0.181	-0.134	0.049
2	1995-2002	Lending Rate	-2.624	0.262	-0.146	0.119
3	1996-2003	Lending Rate	-2.867	0.306	-0.158	0.100
4	1997-2004	Lending Rate	-3.000	0.348	-0.156	0.108
5	1998-2005	Lending Rate	-2.798	0.298	-0.084	0.451
6	1999-2006	Lending Rate	-2.727	0.317	-0.073	0.420
7	2000-2007	Lending Rate	-3.7**	0.368***	-0.043	0.623
	1994-2007	**Lending Rate**	**-2.948**	**0.448****	**-0.400**	**0.000**

TABLE B4			Engle and Granger Model			
			ADF	CRDW	ECM coefficient	*ECM (prob).*
Conc. Rank		Dep. Variable				
	ZAMBIA					
1	1994-2001	Deposit Rate	-2.383	0.248	-0.242	0.026
2	1995-2002	Deposit Rate	-2.134	0.235	-0.305	0.004
3	1996-2003	Deposit Rate	-3.865**	0.703*	-0.563	0.000
4	1997-2004	Deposit Rate	-2.578	0.578*	-0.394	0.000
5	1998-2005	Deposit Rate	-1.983	0.456**	-0.437	0.000
6	1999-2006	Deposit Rate	-1.981	0.465**	-0.399	0.000
7	2000-2007	Deposit Rate	-2.548	0.239	0.032	0.000
	1994-2007	**Deposit Rate**	**-3.865****	**0.483****	**-0.334**	**0.000**
1	1994-2001	Lending Rate	-2.636	0.489**	-0.441	0.000
2	1995-2002	Lending Rate	-3.4**	0.430**	-0.435	0.000
3	1996-2003	Lending Rate	-3.201*	0.374***	-0.353	0.000
4	1997-2004	Lending Rate	-1.606	0.386**	-0.344	0.002
5	1998-2005	Lending Rate	-7.032*	1.377*	-1.112	0.000
6	1999-2006	Lending Rate	-5.823*	1.082*	-0.537	0.000
7	2000-2007	Lending Rate	-1.745	0.101	-0.911	0.000
	1994-2007	**Lending Rate**	**-5.45***	**0.920***	**-0.462**	**0.000**

TABLE B5: CR3 Concentration vs. presence of cointegration in rolling windows

Conc. Rank	Conc. Level	Deposit Rate	Lending Rate	Country
1	0.97	Yes	Yes	BOTS
2	0.96	Yes	Yes	BOTS
3	0.94	No	Yes	BOTS
4	0.92	Yes	Yes	BOTS
5	0.89	Yes	Yes	BOTS
6	0.89	Yes	Yes	RSA
7	0.89	Yes	Yes	RSA
8	0.88	No	No	RSA
9	0.87	Yes	Yes	RSA
10	0.87	No	Yes	BOTS
11	0.86	Yes	Yes	RSA
12	0.84	No	Yes	BOTS
13	0.84	Yes	Yes	RSA
14	0.83	Yes	Yes	RSA
15	0.74	Yes	Yes	ZAM
16	0.71	Yes	Yes	ZAM
17	0.68	Yes	Yes	ZAM
18	0.66	Yes	Yes	ZAM
19	0.62	Yes	Yes	ZAM
20	0.61	Yes	Yes	ZAM
21	0.6	Yes	Yes	ZAM
22	0.5	Yes	No	NIG
23	0.45	Yes	No	NIG
24	0.41	Yes	No	NIG
25	0.4	Yes	Yes	NIG
26	0.4	Yes	No	NIG
27	0.4	Yes	Yes	NIG
28	0.4	Yes	No	NIG

SECTION C: ERROR CORRECTION RESULTS

ΔBR is the change in the central bank/policy rate
ΔDeposit Rate representes change in the deposit rate
ΔLending Rate represents change in the lending rate
The symmetric error correction coefficient is denoted by EC_{t-1}
The asymmetric error correction coefficient representing adjustments down to equilibrium is denoted by EC^{+}_{t-1}
The asymmetric error correction coefficient representing adjustments up to equilibrium is denoted by EC^{-}_{t-1}

TABLE C1			Explanatory Variables									
Conc. Rank		**Dep. Variable**	Constant	*Prob.*	ΔBR	*Prob.*	EC_{t-1}	*Prob.*	EC^{+}_{t-1}	*Prob.*	EC^{-}_{t-1}	*Prob.*
	SOUTH AFRICA											
7	1994-2001	ΔDeposit Rate	0.000	0.996	0.782	0.000	-0.407	0.000				
		ΔDeposit Rate	-0.041	0.618	0.777	0.000			-0.325	0.037	-0.542	0.012
6	1995-2002	ΔDeposit Rate	-0.017	0.767	0.759	0.000	-0.497	0.000				
		ΔDeposit Rate	-0.026	0.727	0.759	0.000			-0.473	0.007	-0.535	0.023
5	1996-2003	ΔDeposit Rate	-0.045	0.439	0.759	0.000	-0.379	0.000				
		ΔDeposit Rate	-0.073	0.366	0.760	0.000			-0.319	0.049	-0.466	0.025
4	1997-2004	ΔDeposit Rate	-0.071	0.221	0.767	0.000	-0.399	0.000				
		ΔDeposit Rate	-0.101	0.189	0.769	0.000			-0.328	0.042	-0.499	0.013
2	1998-2005	ΔDeposit Rate	-0.055	0.343	0.779	0.000	-0.392	0.000				
		ΔDeposit Rate	-0.079	0.302	0.781	0.000			-0.336	0.039	-0.472	0.020
1	1999-2006	ΔDeposit Rate	-0.013	0.690	0.613	0.000	-0.113	0.330				
		ΔDeposit Rate	0.030	0.396	0.566	0.000			-0.285	0.293	0.174	0.311
	1994-2007	**ΔDeposit Rate**	**0.005**	**0.899**	**0.771**	**0.000**	**-0.361**	**0.000**				
		ΔDeposit Rate	**-0.010**	**0.839**	**0.772**	**0.000**			**-0.322**	**0.007**	**-0.419**	**0.006**
7	1994-2001	ΔLending Rate	-0.033	0.480	0.741	0.000	-0.496	0.000				
		ΔLending Rate	-0.182	0.001	0.682	0.000			0.294	0.166	-0.964	0.000
6	1995-2002	ΔLending Rate	-0.002	0.968	0.768	0.000	-0.581	0.000				
		ΔLending Rate	-0.124	0.056	0.725	0.000			-0.023	0.926	-0.653	0.025
5	1996-2003	ΔLending Rate	-0.037	0.420	0.807	0.000	-0.446	0.000				
		ΔLending Rate	-0.188	0.001	0.749	0.000			-0.347	0.115	-0.899	0.000
4	1997-2004	ΔLending Rate	-0.052	0.229	0.792	0.000	-0.505	0.000				
		ΔLending Rate	-0.200	0.000	0.725	0.000			-0.514	0.040	-0.926	0.000
2	1998-2005	ΔLending Rate	-0.045	0.294	0.790	0.000	-0.500	0.000				
		ΔLending Rate	-0.203	0.000	0.720	0.000			-0.558	0.029	-0.929	0.000
1	1999-2006	ΔLending Rate	-0.011	0.594	0.869	0.000	0.607	0.000				
		ΔLending Rate	-0.006	0.825	0.866	0.000			-0.661	0.000	-0.542	0.008
	1994-2007	**ΔLending Rate**	**0.000**	**0.997**	**0.820**	**0.000**	**-0.435**	**0.000**				
		ΔLending Rate	**-0.093**	**0.004**	**0.790**	**0.000**			**0.206**	**0.196**	**-0.798**	**0.000**

TABLE C2			Explanatory Variables									
Conc. Rank		**Dep. Variable**	Constant	*Prob.*	ΔBR	*Prob.*	EC_{t-1}	*Prob.*	EC^{+}_{t-1}	*Prob.*	EC^{-}_{t-1}	*Prob.*
	BOTSWANA											
1	1994-2001	ΔDeposit Rate	-0.036	0.563	-0.136	0.456	-0.408	0.000				
		ΔDeposit Rate	0.119	0.042	-0.044	0.775			-1.108	0.000	0.067	0.556
2	1995-2002	ΔDeposit Rate	0.001	0.978	0.070	0.653	-0.351	0.000				
		ΔDeposit Rate	0.120	0.004	0.073	0.549			-1.181	0.000	0.069	0.444
4	1997-2004	ΔDeposit Rate	0.003	0.912	0.067	0.374	-0.050	0.642				
		ΔDeposit Rate	0.022	0.446	0.066	0.375			-0.190	0.238	0.120	0.507
5	1998-2005	ΔDeposit Rate	-0.005	0.850	0.063	0.422	-0.039	0.717				
		ΔDeposit Rate	0.009	0.754	0.061	0.438			-0.145	0.389	0.069	0.683
	1994-2007	**ΔDeposit Rate**	**-0.015**	**0.657**	**0.100**	**0.373**	**-0.347**	**0.000**				
		ΔDeposit Rate	**0.093**	**0.156**	**0.144**	**0.007**			**-0.891**	**0.000**	**0.079**	**0.378**
1	1994-2001	ΔLending Rate	0.022	0.183	0.102	0.050	-0.239	0.004				
		ΔLending Rate	0.023	0.221	0.104	0.052			-0.260	0.073	-0.228	0.032
2	1995-2002	ΔLending Rate	0.030	0.053	0.159	0.003	-0.152	0.110				
		ΔLending Rate	0.022	0.211	0.147	0.007			-0.063	0.648	-0.256	0.088
3	1996-2003	ΔLending Rate	0.017	0.320	0.264	0.000	-0.257	0.026				
		ΔLending Rate	0.003	0.856	0.242	0.000			-0.107	0.477	-0.515	0.013
4	1997-2004	ΔLending Rate	0.015	0.368	0.206	0.000	0.011	0.887				
		ΔLending Rate	0.007	0.689	0.219	0.000			-0.094	0.517	-0.459	0.018
5	1998-2005	ΔLending Rate	0.030	0.058	0.245	0.000	-0.267	0.014				
		ΔLending Rate	0.017	0.332	0.225	0.000			-0.124	0.375	-0.526	0.009
6	1999-2006	ΔLending Rate	0.026	0.069	0.278	0.000	-0.234	0.038				
		ΔLending Rate	0.025	0.121	0.276	0.000			-0.220	0.143	-0.256	0.211
7	2000-2007	ΔLending Rate	0.005	0.667	0.388	0.000	-0.505	0.000				
		ΔLending Rate	0.000	0.984	0.384	0.000			-0.478	0.000	-0.606	0.018
	1994-2007	**ΔLending Rate**	**0.013**	**0.339**	**0.413**	**0.000**	**-0.353**	**0.000**				
		ΔLending Rate	**0.006**	**0.704**	**0.408**	**0.000**			**-0.272**	**0.028**	**-0.414**	**0.000**

TABLE C3							Explanatory Variables					
Conc. Rank		**Dep. Variable**	Constant	*Prob.*	ΔBR	*Prob.*	EC_{t-1}	*Prob.*	EC^{+}_{t-1}	*Prob.*	EC^{-}_{t-1}	*Prob.*
	NIGERIA											
1	1994-2001	ΔDeposit Rate	0.029	0.791	0.027	0.037	-0.241	0.020				
		ΔDeposit Rate	0.145	0.276	0.139	0.003			-0.489	0.011	-0.079	0.582
2	1995-2002	ΔDeposit Rate	-0.032	0.788	0.138	0.003	-0.308	0.005				
		ΔDeposit Rate	0.073	0.634	0.196	0.046			-0.481	0.014	-0.168	0.315
3	1996-2003	ΔDeposit Rate	-0.026	0.840	0.039	0.001	-0.330	0.002				
		ΔDeposit Rate	0.126	0.470	0.103	0.005			-0.518	0.004	-0.142	0.420
4	1997-2004	ΔDeposit Rate	0.005	0.967	0.035	0.009	-0.313	0.003				
		ΔDeposit Rate	0.212	0.241	0.115	0.007			-0.551	0.002	-0.085	0.614
5	1998-2005	ΔDeposit Rate	-0.004	0.976	0.093	0.051	-0.443	0.000				
		ΔDeposit Rate	0.030	0.871	0.103	0.002			-0.477	0.008	-0.392	0.093
6	1999-2006	ΔDeposit Rate	-0.036	0.771	0.053	0.008	-0.447	0.000				
		ΔDeposit Rate	-0.072	0.698	0.041	0.008			-0.412	0.017	-0.493	0.018
7	2000-2007	ΔDeposit Rate	-0.021	0.860	0.025	0.043	-0.428	0.000				
		ΔDeposit Rate	-0.071	0.690	0.007	0.038			-0.378	0.024	-0.495	0.016
	1994-2007	**ΔDeposit Rate**	**-0.015**	**0.872**	**0.459**	**0.000**	**-0.392**	**0.000**				
		ΔDeposit Rate	**0.220**	**0.060**	**0.455**	**0.000**			**-0.726**	**0.000**	**-0.133**	**0.225**
1	1994-2001	ΔLending Rate	0.024	0.679	0.154	0.006	-0.134	0.049				
		ΔLending Rate	0.158	0.037	0.171	0.029			-0.589	0.001	0.002	0.984
7	2000-2007	ΔLending Rate	-0.048	0.463	0.056	0.043	-0.043	0.623				
		ΔLending Rate	-0.041	0.647	0.055	0.001			-0.057	0.687	-0.028	0.853
	1994-2007	**ΔLending Rate**	**-0.002**	**0.986**	**0.707**	**0.000**	**-0.400**	**0.000**				
		ΔLending Rate	**0.096**	**0.374**	**0.706**	**0.000**			**-0.536**	**0.000**	**-0.252**	**0.037**

TABLE C4							Explanatory Variables					
Conc. Rank		**Dep. Variable**	Constant	*Prob.*	ΔBR	*Prob.*	EC_{t-1}	*Prob.*	EC^{+}_{t-1}	*Prob.*	EC^{-}_{t-1}	*Prob.*
	ZAMBIA											
1	1994-2001	ΔDeposit Rate	0.006	0.919	0.782	0.000	-0.404	0.000				
		ΔDeposit Rate	-0.030	0.709	0.777	0.000			-0.318	0.038	-0.529	0.012
2	1995-2002	ΔDeposit Rate	-0.012	0.836	0.771	0.000	-0.403	0.000				
		ΔDeposit Rate	-0.054	0.485	0.768	0.000			-0.316	0.037	-0.548	0.009
3	1996-2003	ΔDeposit Rate	-0.040	0.495	0.759	0.000	-0.374	0.000				
		ΔDeposit Rate	-0.066	0.413	0.760	0.000			-0.320	0.046	-0.459	0.030
4	1997-2004	ΔDeposit Rate	-0.066	0.252	0.768	0.000	-0.396	0.000				
		ΔDeposit Rate	-0.096	0.212	0.769	0.000			-0.328	0.041	-0.497	0.016
5	1998-2005	ΔDeposit Rate	-0.023	0.493	0.636	0.000	-0.135	0.204				
		ΔDeposit Rate	0.006	0.912	0.623	0.000			-0.292	0.207	-0.039	0.814
6	1999-2006	ΔDeposit Rate	-0.052	0.374	0.779	0.000	-0.390	0.001				
		ΔDeposit Rate	-0.075	0.325	0.781	0.000			-0.335	0.037	-0.472	0.022
7	2000-2007	ΔDeposit Rate	0.022	0.431	0.567	0.004	0.320	0.000				
		ΔDeposit Rate	0.095	0.021	0.536	0.000			-0.391	0.060	0.385	0.037
	1994-2007	**ΔDeposit Rate**	**-0.006**	**0.860**	**0.766**	**0.000**	**-0.334**	**0.000**				
		ΔDeposit Rate	**-0.014**	**0.754**	**0.766**	**0.000**			**-0.306**	**0.007**	**-0.369**	**0.009**
1	1994-2001	ΔLending Rate	-0.035	0.458	0.749	0.000	-0.471	0.000				
		ΔLending Rate	-0.187	0.001	0.696	0.000			0.317	0.148	-0.951	0.000
2	1995-2002	ΔLending Rate	-0.013	0.775	0.776	0.000	-0.435	0.000				
		ΔLending Rate	-0.181	0.003	0.732	0.000			0.351	0.111	-0.928	0.000
3	1996-2003	ΔLending Rate	-0.037	0.417	0.813	0.000	-0.413	0.001				
		ΔLending Rate	-0.201	0.001	0.759	0.000			0.389	0.084	-0.891	0.000
4	1997-2004	ΔLending Rate	-0.054	0.220	0.799	0.000	-0.474	0.000				
		ΔLending Rate	-0.218	0.000	0.733	0.000			0.612	0.021	-0.920	0.000
5	1998-2005	ΔLending Rate	-0.046	0.286	0.797	0.000	-0.467	0.000				
		ΔLending Rate	-0.225	0.000	0.728	0.000			0.678	0.013	-0.932	0.000
6	1999-2006	ΔLending Rate	-0.024	0.273	0.881	0.000	-0.328	0.000				
		ΔLending Rate	0.012	0.747	0.874	0.000			-0.602	0.015	-0.204	0.131
7	2000-2007	ΔLending Rate	-0.025	0.470	0.485	0.000	-0.911	0.000				
		ΔLending Rate	-0.067	0.120	0.464	0.000			-0.724	0.000	-1.039	0.000
	1994-2007	**ΔLending Rate**	**-0.006**	**0.804**	**0.773**	**0.000**	**-0.462**	**0.000**				
		ΔLending Rate	**-0.056**	**0.097**	**0.758**	**0.000**			**-0.169**	**0.269**	**-0.663**	**0.340**

SECTION D: MEAN ADJUSTMENT LAGS

Italicised lags are not statistically significant given the probability values or the sign of their corresponding error correction term's coefficient. Additionally, only where both the coefficients EC+t-1 and EC-t-1 lags are statistically significant do we apply the Wald test to determine if the resultant mean adjustment lags are truly different.

MAL: Symmetric Mean Adjustment Lag

MAL+: Mean Adjustment Lag when the bank rate is above its equilibrium with the official rate and the impulse is for bank rates to fall

MAL-: Mean Adjustment Lag when the bank rate is below its equilibrium with the official rate and the impulse is for bank rates to rise

TABLE D1			**MAL**	**MAL+**	**MAL-**	**WALD TEST**	
Conc. Rank							
	SOUTH AFRICA	**Dep. Variable**				*F-stat*	*Prob.*
7	1994-2001	Deposit Rate	0.536	0.685	0.411	7.363	0
6	1995-2002	Deposit Rate	0.485	0.509	0.45	8.61	0
5	1996-2003	Deposit Rate	0.637	0.751	0.515	6.306	0.003
4	1997-2004	Deposit Rate	0.583	0.705	0.464	6.898	0.002
2	1998-2005	Deposit Rate	0.564	0.654	0.465	6.401	0.003
1	1999-2006	Deposit Rate	3.425	1.523	2.494	N/A	N/A
	1994-2007	**Deposit Rate**	**0.633**	**0.708**	**0.545**	**10.358**	**0**
7	1994-2001	Lending Rate	0.523	1.082	0.33	7.738	0.001
6	1995-2002	Lending Rate	0.399	12.041	0.422	8.321	0
5	1996-2003	Lending Rate	0.434	*0.725*	0.28	9.326	0.005
4	1997-2004	Lending Rate	0.412	0.535	0.298	7.152	0.001
2	1998-2005	Lending Rate	0.42	0.501	0.301	6.356	0.003
1	1999-2006	Lending Rate	0.215	0.203	0.248	13.215	0
	1994-2007	**Lending Rate**	**0.413**	**1.018**	**0.263**	**25.715**	**0**

TABLE D2			**MAL**	**MAL+**	**MAL-**	**WALD TEST**	
Conc. Rank							
	BOTSWANA	**Dep. Variable**				*F-stat*	*Prob.*
1	1994-2001	Deposit Rate	2.786	0.942	*15.619*	N/A	N/A
2	1995-2002	Deposit Rate	2.647	0.785	*13.506*	N/A	N/A
4	1997-2004	Deposit Rate	*18.554*	*4.908*	*7.79*	N/A	N/A
5	1998-2005	Deposit Rate	*24.042*	*6.458*	*13.544*	N/A	N/A
	1992-2007	**Deposit Rate**	**2.594**	***0.961***	***10.861***	**37.88**	**0**
1	1994-2001	Lending Rate	3.756	3.453	3.937	14.356	0
2	1995-2002	Lending Rate	*5.52*	*13.571*	*3.331*	N/A	N/A
3	1996-2003	Lending Rate	2.868	*7.108*	1.471	N/A	N/A
4	1997-2004	Lending Rate	*74.947*	*8.284*	1.702	N/A	N/A
5	1998-2005	Lending Rate	2.832	*6.238*	1.473	N/A	N/A
6	1999-2006	Lending Rate	3.088	*3.283*	*2.823*	N/A	N/A
7	2000-2007	Lending Rate	1.211	1.289	1.017	12.3654	0
	1992-2007	**Lending Rate**	**1.665**	**2.175**	**1.428**	**11.48**	**0**

TABLE D3			**MAL**	**MAL+**	**MAL-**	**WALD TEST**	
Conc. Rank							
	NIGERIA	**Dep. Variable**				*F-stat*	*Prob.*
1	1994-2001	Deposit Rate	4.042	1.76	*10.826*	N/A	N/A
2	1995-2002	Deposit Rate	2.8	1.674	*4.784*	N/A	N/A
3	1996-2003	Deposit Rate	2.913	1.73	*6.298*	N/A	N/A
4	1997-2004	Deposit Rate	3.081	1.607	*10.357*	N/A	N/A
5	1998-2005	Deposit Rate	2.049	1.882	*2.286*	N/A	N/A
6	1999-2006	Deposit Rate	2.119	2.33	1.945	9.372	0
7	2000-2007	Deposit Rate	2.28	2.625	2.008	8.629	0
	1992-2007	**Deposit Rate**	**1.38**	**0.751**	***4.097***	**19.747**	**0**
1	1994-2001	Lending Rate	6.31	1.408	*515.111*	N/A	N/A
7	2000-2007	Lending Rate	*21.814*	*16.465*	*33.91*	N/A	N/A
	1992-2007	**Lending Rate**	**0.732**	**0.548**	**1.168**	**15.784**	**0**

TABLE D4			**MAL**	**MAL+**	**MAL-**	**WALD TEST**	
Conc. Rank							
	ZAMBIA	**Dep. Variable**				*F-stat*	*Prob.*
1	1994-2001	Deposit Rate	0.539	0.7	0.421	7.806	0.001
2	1995-2002	Deposit Rate	0.567	0.734	0.423	7.935	0.001
3	1996-2003	Deposit Rate	0.644	0.75	0.522	6.149	0.003
4	1997-2004	Deposit Rate	0.587	0.705	0.465	6.763	0.002
5	1998-2005	Deposit Rate	*2.704*	*1.291*	*9.752*	N/A	N/A
6	1999-2006	Deposit Rate	0.566	0.653	0.464	8.256	0.003
7	2000-2007	Deposit Rate	-13.369	*1.185*	1.204	N/A	N/A
	1992-2007	**Deposit Rate**	**0.7**	**0.765**	**0.635**	**10.107**	**0**
1	1994-2001	Lending Rate	0.533	*0.959*	0.319	N/A	N/A
2	1995-2002	Lending Rate	0.515	*0.763*	0.288	N/A	N/A
3	1996-2003	Lending Rate	0.452	*0.619*	0.27	N/A	N/A
4	1997-2004	Lending Rate	0.425	0.435	0.29	6.326	0
5	1998-2005	Lending Rate	0.435	0.4	0.291	8.256	0
6	1999-2006	Lending Rate	0.363	0.208	0.615	9.365	0
7	2000-2007	Lending Rate	0.565	0.74	0.516	7.325	0
	1992-2007	**Lending Rate**	**0.492**	***1.431***	***0.366***	N/A	N/A

SECTION E: SHORT RUN (SR) MAGNITUDE OF ADJUSTMENT

SR (ΔBR) is the short run symmetric change in the official /policy rate
SR (ΔBR)+ is the short run asymmetric positive change in the official/policy rate
SR (ΔBR)- is the short run asymmetric negative change in the official/policy rate

Table E1			Explanatory Variables									
Conc. Rank		**Dep.Variable**	Constant	*prob.*	SR (ΔBR)	*prob.*	Constant	*prob.*	SR (ΔBR)+	*prob.*	SR (ΔBR)-	*prob.*
	SOUTH AFRICA											
7	1994-2001	Deposit Rate	0.006	0.929	0.737	0.000	-0.003	0.963	0.762	0.000	0.700	0.000
6	1995-2002	Deposit Rate	-0.003	0.959	0.723	0.000	-0.011	0.878	0.742	0.000	0.692	0.000
5	1996-2003	Deposit Rate	-0.019	0.757	0.714	0.000	-0.023	0.747	0.725	0.000	0.700	0.000
4	1997-2004	Deposit Rate	-0.032	0.598	0.728	0.000	-0.046	0.504	0.771	0.000	0.682	0.000
2	1998-2005	Deposit Rate	-0.013	0.828	0.740	0.000	-0.018	0.790	0.755	0.000	0.722	0.000
1	1999-2006	Deposit Rate	-0.018	0.365	0.730	0.000	-0.050	0.568	0.748	0.000	0.739	0.000
3	2000-2007	Deposit Rate	0.010	0.717	0.586	0.000	0.013	0.686	0.567	0.000	0.596	0.000
	1994-2007	**Deposit Rate**	0.005	0.904	0.720	0.000	0.005	0.906	0.719	0.000	0.722	0.000
7	1994-2001	Lending Rate	-0.004	0.942	0.762	0.000	-0.002	0.969	0.757	0.000	0.768	0.000
6	1995-2002	Lending Rate	0.004	0.000	0.780	0.000	0.002	0.979	0.786	0.000	0.786	0.000
5	1996-2003	Lending Rate	-0.013	0.783	0.819	0.000	-0.008	0.883	0.806	0.000	0.834	0.000
4	1997-2004	Lending Rate	-0.016	0.722	0.810	0.000	-0.008	0.885	0.786	0.000	0.837	0.000
2	1998-2005	Lending Rate	-0.015	0.733	0.807	0.000	-0.008	0.878	0.786	0.000	0.831	0.000
1	1999-2006	Lending Rate	-0.014	0.557	0.833	0.000	-0.040	0.124	1.037	0.000	0.759	0.000
3	2000-2007	Lending Rate	-0.001	0.939	0.902	0.000	-0.017	0.251	1.012	0.000	0.837	0.000
	1994-2007	**Lending Rate**	0.987	0.000	0.826	0.000	0.006	0.849	0.806	0.000	0.852	0.000

Table E2			Explanatory Variables									
Conc. Rank		**Dep.Variable**	Constant	*prob.*	SR (ΔBR)	*prob.*	Constant	*prob.*	SR (ΔBR)+	*prob.*	SR (ΔBR)-	*prob.*
	BOTSWANA											
1	1994-2001	Deposit Rate	-0.037	0.586	-0.050	0.790	0.022	0.750	-0.519	0.053	0.425	0.114
2	1995-2002	Deposit Rate	-0.016	0.779	-0.063	0.730	9.578	0.000	-0.207	0.517	0.193	0.584
3	1996-2003	Deposit Rate	-0.003	0.902	0.064	0.319	0.001	0.971	0.036	0.697	0.098	0.321
4	1997-2004	Deposit Rate	0.003	0.823	0.064	0.385	0.007	0.773	0.029	0.782	0.104	0.350
5	1998-2005	Deposit Rate	-0.006	0.792	0.062	0.427	-0.006	0.820	0.057	0.594	0.068	0.579
6	1999-2006	Deposit Rate	0.001	0.979	0.052	0.484	-0.001	0.953	0.071	0.492	0.029	0.799
7	2000-2007	Deposit Rate	-0.007	0.752	0.042	0.563	-0.008	0.727	0.055	0.602	0.029	0.788
	1992-2007	**Deposit Rate**	-0.015	0.676	0.086	0.472	0.010	0.781	-0.131	0.414	0.374	0.046
1	1994-2001	Lending Rate	0.008	0.724	0.179	0.005	0.032	0.155	-0.016	0.852	0.376	0.000
2	1995-2002	Lending Rate	0.008	0.761	0.188	0.005	0.034	0.163	-0.017	0.894	0.395	0.000
3	1996-2003	Lending Rate	0.010	0.544	0.228	0.000	0.014	0.415	0.190	0.012	0.272	0.001
4	1997-2004	Lending Rate	0.010	0.544	0.228	0.000	0.014	0.415	0.190	0.012	0.272	0.000
5	1998-2005	Lending Rate	0.019	0.236	0.208	0.000	0.020	0.246	0.201	0.006	0.217	0.009
6	1999-2006	Lending Rate	0.018	0.206	0.239	0.000	0.015	0.299	0.262	0.000	0.211	0.004
7	2000-2007	Lending Rate	0.007	0.519	0.256	0.000	0.006	0.677	0.270	0.000	0.241	0.000
	1992-2007	**Lending Rate**	0.014	0.339	0.360	0.000	0.021	0.160	0.295	0.000	0.446	0.000

Table E3			Explanatory Variables									
Conc. Rank		**Dep.Variable**	Constant	*prob.*	SR (ΔBR)	*prob.*	Constant	*prob.*	SR (ΔBR)+	*prob.*	SR (ΔBR)-	*prob.*
	NIGERIA											
1	1994-2001	Deposit Rate	-0.019	0.875	0.701	0.000	-0.004	0.968	0.780	0.004	0.833	0.000
2	1995-2002	Deposit Rate	-0.014	0.789	0.739	0.000	-0.002	0.948	0.713	0.000	0.780	0.000
3	1996-2003	Deposit Rate	-0.018	0.735	0.691	0.000	-0.007	0.929	0.714	0.000	0.656	0.000
4	1997-2004	Deposit Rate	-0.031	0.579	0.678	0.000	-0.006	0.910	0.705	0.000	0.635	0.000
5	1998-2005	Deposit Rate	-0.013	0.803	0.669	0.000	-0.037	0.891	0.680	0.000	0.657	0.000
6	1999-2006	Deposit Rate	-0.025	0.456	0.683	0.000	-0.007	0.873	0.723	0.000	0.640	0.000
7	2000-2007	Deposit Rate	0.019	0.463	0.693	0.000	0.365	0.855	0.708	0.000	0.677	0.000
	1992-2007	**Deposit Rate**	-0.008	0.938	0.482	0.000	0.034	0.720	0.429	0.007	0.700	0.000
1	1994-2001	Lending Rate	-0.046	0.571	1.036	0.000	0.104	0.130	0.128	0.342	1.177	0.000
2	1995-2002	Lending Rate	-0.042	0.527	0.110	0.344	0.110	0.776	0.196	0.213	-0.008	0.968
3	1996-2003	Lending Rate	-0.039	0.486	0.128	0.272	0.092	0.917	0.181	0.196	-0.007	0.893
4	1997-2004	Lending Rate	-0.036	0.448	0.118	0.251	0.078	0.085	0.167	0.181	-0.007	0.824
5	1998-2005	Lending Rate	-0.033	0.414	0.109	0.231	0.070	0.366	0.154	0.167	-0.006	0.760
6	1999-2006	Lending Rate	-0.031	0.382	0.101	0.214	0.062	0.237	0.142	0.154	-0.006	0.701
7	2000-2007	Lending Rate	-0.047	0.470	0.044	0.618	-0.073	0.293	0.204	0.253	-0.023	0.829
	1992-2007	**Lending Rate**	0.008	0.000	0.701	0.000	0.147	0.099	-0.069	0.643	0.989	0.000

Table E4			Explanatory Variables									
Conc. Rank		**Dep.Variable**	Constant	*prob.*	SR (ΔBR)	*prob.*	Constant	*prob.*	SR (ΔBR)+	*prob.*	SR (ΔBR)-	*prob.*
	ZAMBIA											
1	1994-2001	Deposit Rate	0.006	0.929	0.737	0.000	-0.003	0.963	0.762	0.000	0.700	0.000
2	1995-2002	Deposit Rate	-0.015	0.814	0.723	0.000	-0.026	0.716	0.752	0.000	0.677	0.000
3	1996-2003	Deposit Rate	-0.019	0.757	0.714	0.000	-0.023	0.747	0.725	0.000	0.700	0.000
4	1997-2004	Deposit Rate	-0.032	0.598	0.728	0.000	-0.046	0.504	0.771	0.000	0.682	0.000
5	1998-2005	Deposit Rate	-0.013	0.828	0.740	0.000	-0.018	0.790	0.755	0.000	0.722	0.000
6	1999-2006	Deposit Rate	-0.025	0.470	0.622	0.000	-0.021	0.591	0.589	0.000	0.633	0.000
7	2000-2007	Deposit Rate	0.019	0.477	0.573	0.000	0.022	0.474	0.555	0.000	0.583	0.000
	1992-2007	**Deposit Rate**	-0.010	0.780	0.716	0.000	-0.014	0.724	0.733	0.000	0.699	0.000
1	1994-2001	Lending Rate	-0.004	0.942	0.762	0.000	-0.002	0.969	0.757	0.000	0.768	0.000
2	1995-2002	Lending Rate	0.004	0.939	0.780	0.000	0.001	0.979	0.786	0.000	0.771	0.000
3	1996-2003	Lending Rate	-0.013	0.783	0.819	0.000	-0.008	0.883	0.806	0.000	0.834	0.000
4	1997-2004	Lending Rate	-0.016	0.722	0.810	0.000	-0.008	0.885	0.786	0.000	0.837	0.000
5	1998-2005	Lending Rate	-0.015	0.733	0.807	0.000	-0.008	0.878	0.786	0.000	0.831	0.000
6	1999-2006	Lending Rate	-0.019	0.437	0.843	0.000	-0.044	0.098	1.042	0.000	0.771	0.000
7	2000-2007	Lending Rate	0.007	0.000	0.891	0.000	-0.009	0.440	1.002	0.000	0.826	0.000
	1992-2007	**Lending Rate**	-0.006	0.832	0.771	0.000	-0.019	0.534	0.825	0.000	0.714	0.000

SECTION E continued...: LONG RUN (LR) MAGNITUDE OF ADJUSTMENT

LR (BR) is the short run symmetric positive change in the official/policy rate
LR (ΔBR+) is the short run asymmetric positive change in the official/policy rate
LR (ΔBR-) is the short run asymmetric negative change in the official/policy rate

Table E5			Explanatory Variables							
Conc. Rank		**Dep. Variable**	Constant	*prob.*	LR (BR)	*prob.*	Constant	*prob.*	LR (ΔBR+)	LR (ΔBR-)
	SOUTH AFRICA									
7	1994-2001	Deposit Rate	-1.412	0.002	0.983	0.000	0.007	1.222	0.935	0.931
6	1995-2002	Deposit Rate	-1.462	0.001	0.984	0.000	0.037	0.583	0.953	0.970
5	1996-2003	Deposit Rate	-1.401	0.000	0.973	0.000	0.004	0.831	1.013	1.009
4	1997-2004	Deposit Rate	-0.909	0.001	0.931	0.000	0.052	0.597	1.104	1.085
2	1998-2005	Deposit Rate	-0.435	0.041	0.887	0.000	0.014	0.774	1.114	1.082
1	1999-2006	Deposit Rate	-0.428	0.000	0.864	0.000	0.046	0.727	1.171	1.096
3	2000-2007	Deposit Rate	0.217	0.563	0.908	-	0.083	0.531	1.005	1.047
	1994-2007	**Deposit Rate**	-0.389	0.046	0.916	0.000	0.021	0.590	0.925	0.850
7	1994-2001	Lending Rate	2.718	0.000	1.033	0.000	0.028	0.418	1.295	1.157
6	1995-2002	Lending Rate	2.881	0.000	1.024	0.000	-0.028	1.540	1.333	1.127
5	1996-2003	Lending Rate	3.097	0.000	1.010	0.000	0.042	0.431	1.252	1.115
4	1997-2004	Lending Rate	3.430	0.000	0.984	0.000	-0.072	1.125	1.240	1.147
2	1998-2005	Lending Rate	3.575	0.000	0.973	0.000	0.034	0.522	1.371	1.113
1	1999-2006	Lending Rate	3.690	0.000	0.964	0.000	-0.081	0.918	1.247	1.179
3	2000-2007	Lending Rate	0.004	0.842	1.018	-	-0.071	0.584	1.337	1.094
	1994-2007	**Lending Rate**	3.544	0.000	0.982	0.000	-0.033	0.245	1.101	0.949

Table E6			Explanatory Variables							
Conc. Rank		**Dep. Variable**	Constant	*prob.*	LR (BR)	*prob.*	Constant	*prob.*	LR (ΔBR+)	L (ΔBR-)
	BOTSWANA									
1	1994-2001	Deposit Rate	4.038	0.003	0.417	0.000	0.019	0.595	0.703	0.699
2	1995-2002	Deposit Rate	2.621	0.002	0.516	0.000	-0.026	0.583	0.723	0.742
3	1996-2003	Deposit Rate	0.209	0.542	0.805	-	-0.014	0.335	0.789	0.785
4	1997-2004	Deposit Rate	-0.375	0.044	0.884	-	0.084	0.086	0.884	0.845
5	1998-2005	Deposit Rate	1.108	0.100	0.606	0.000	0.030	0.531	0.808	0.830
6	1999-2006	Deposit Rate	2.775	0.000	0.905	-	-0.033	0.727	0.913	0.857
7	2000-2007	Deposit Rate	2.983	0.000	0.681	-	0.062	0.063	0.546	0.786
	1992-2007	**Deposit Rate**	5.884	0.001	0.295	0.007	0.009	0.815	0.271	0.923
1	1994-2001	Lending Rate	4.099	0.000	0.788	0.000	0.078	0.079	1.008	0.820
2	1995-2002	Lending Rate	4.304	0.000	0.828	0.000	-0.040	0.351	0.987	0.845
3	1996-2003	Lending Rate	1.872	0.000	0.973	0.000	-0.039	0.504	0.917	0.818
4	1997-2004	Lending Rate	1.893	0.000	0.972	0.000	-0.051	0.675	0.912	0.856
5	1998-2005	Lending Rate	1.907	0.000	0.971	0.000	-0.041	0.149	1.196	0.816
6	1999-2006	Lending Rate	3.097	0.000	0.889	0.000	-0.050	0.439	0.981	0.903
7	2000-2007	Lending Rate	4.253	0.000	0.811	0.000	-0.005	0.660	0.625	0.586
	1992-2007	**Lending Rate**	1.591	0.005	0.976	0.000	0.015	0.291	0.773	0.797

Table E7						Explanatory Variables				
Conc. Rank		**Dep. Variable**	Constant	*prob.*	LR (BR)	*prob.*	Constant	*prob.*	LR (ΔBR+)	L (ΔBR-)
	NIGERIA									
1	1994-2001	Deposit Rate	3.519	0.030	0.567	0.000	0.017	0.531	0.628	0.624
2	1995-2002	Deposit Rate	5.666	0.001	0.669	-	0.074	0.520	0.645	0.663
3	1996-2003	Deposit Rate	7.506	0.000	0.719	-	0.021	0.299	0.705	0.701
4	1997-2004	Deposit Rate	6.795	0.000	0.817	-	0.026	0.814	0.801	0.796
5	1998-2005	Deposit Rate	3.947	0.000	0.860	-	-0.036	0.798	0.880	0.802
6	1999-2006	Deposit Rate	4.145	0.652	0.874	-	-0.020	0.459	0.902	0.807
7	2000-2007	Deposit Rate	1.803	0.257	0.849	-	0.115	0.117	0.887	0.772
	1992-2007	**Deposit Rate**	-0.016	0.983	0.856	0.000	-0.037	0.732	0.726	0.612
1	1994-2001	Lending Rate	12.874	0.000	0.484	0.000	-0.041	0.538	0.978	0.873
2	1995-2002	Lending Rate	1.532	0.004	0.965	-	-0.054	0.720	0.973	0.913
3	1996-2003	Lending Rate	-2.356	0.562	1.098	-	-0.043	0.159	1.276	0.871
4	1997-2004	Lending Rate	-4.236	0.356	1.028	-	-0.053	0.468	1.046	0.964
5	1998-2005	Lending Rate	-3.365	0.432	0.932	-	-0.005	0.704	0.987	0.835
6	1999-2006	Lending Rate	-3.890	0.000	1.025	-	-0.035	0.168	1.074	0.931
7	2000-2007	Lending Rate	8.166	0.000	0.796	0.000	-0.089	0.457	0.687	0.997
	1992-2007	**Lending Rate**	6.612	0.000	0.917	0.000	0.135	0.139	0.465	1.088

Table E8						Explanatory Variables				
Conc. Rank		**Dep. Variable**	Constant	*prob.*	LR (BR)	*prob.*	Constant	*prob.*	LR (ΔBR+)	L (ΔBR-)
	ZAMBIA									
1	1994-2001	Deposit Rate	-1.412	0.002	0.983	0.000	0.021	0.650	0.984	0.956
2	1995-2002	Deposit Rate	-1.462	0.000	0.984	0.000	-0.028	0.637	0.790	0.811
3	1996-2003	Deposit Rate	-1.401	0.001	0.973	0.000	-0.016	0.366	0.974	0.897
4	1997-2004	Deposit Rate	-0.909	0.001	0.931	0.000	0.092	0.094	0.966	0.924
5	1998-2005	Deposit Rate	-0.435	0.041	0.887	0.000	0.033	0.581	0.883	0.907
6	1999-2006	Deposit Rate	0.568	0.005	0.796	0.000	-0.036	0.795	0.998	0.937
7	2000-2007	Deposit Rate	0.865	0.017	0.776	0.000	0.068	0.069	0.597	0.859
	1992-2007	**Deposit Rate**	-0.431	0.024	0.921	0.000	0.019	0.598	0.837	0.923
1	1994-2001	Lending Rate	2.718	0.000	1.033	0.000	0.085	0.086	1.102	0.897
2	1995-2002	Lending Rate	2.881	0.000	1.024	0.000	-0.043	0.384	1.079	0.923
3	1996-2003	Lending Rate	3.097	0.000	1.010	0.000	-0.043	0.551	1.002	0.894
4	1997-2004	Lending Rate	3.430	0.000	0.984	0.000	-0.055	0.738	0.997	0.936
5	1998-2005	Lending Rate	3.575	0.000	0.973	0.000	-0.044	0.163	1.307	0.892
6	1999-2006	Lending Rate	3.690	0.000	0.964	0.000	-0.054	0.480	1.072	0.988
7	2000-2007	Lending Rate	4.046	0.507	0.926	0.000	-0.006	0.721	1.012	0.856
	1992-2007	**Lending Rate**	3.525	0.000	0.985	0.000	-0.036	0.172	1.100	0.954

SECTION F: WALD TEST SR AND LR MAGNITUDE OF ADJUSTMENT

SR is the short run
LR is the long run

Table F1

Conc. Rank			SR		LR	
	SOUTH AFRICA		*F-stat*	*Prob.*	*F-stat*	*Prob.*
7	1994-2001	Deposit Rate	15.178	0.000	1.237	0.112
6	1995-2002	Deposit Rate	28.995	0.000	3.266	0.365
5	1996-2003	Deposit Rate	22.168	0.000	3.657	0.127
4	1997-2004	Deposit Rate	14.457	0.000	2.169	0.958
2	1998-2005	Deposit Rate	24.429	0.000	9.327	0.070
1	1999-2006	Deposit Rate	41.870	0.000	4.366	0.668
3	2000-2007	Deposit Rate	0.457	0.366	0.316	0.370
	1994-2007	**Deposit Rate**	52.203	0.000	9.264	0.095
7	1994-2001	Lending Rate	14.501	0.000	15.366	0.040
6	1995-2002	Lending Rate	65.178	0.000	4.366	0.090
5	1996-2003	Lending Rate	75.620	0.000	8.366	0.457
4	1997-2004	Lending Rate	59.572	0.000	5.368	0.126
2	1998-2005	Lending Rate	45.716	0.000	7.366	0.357
1	1999-2006	Lending Rate	8.427	0.000	9.366	0.057
3	2000-2007	Lending Rate	0.146	0.841	0.569	0.889
	1994-2007	**Lending Rate**	123.735	0.000	7.366	0.060

Table F2

Conc. Rank			SR		LR	
	BOTSWANA		*F-stat*	*Prob.*	*F-stat*	*Prob.*
1	1994-2001	Deposit Rate	7.082	0.000	2.895	0.216
2	1995-2002	Deposit Rate	9.237	0.000	8.031	0.012
3	1996-2003	Deposit Rate	3.654	0.652	0.376	0.950
4	1997-2004	Deposit Rate	12.048	0.000	0.981	0.887
5	1998-2005	Deposit Rate	15.715	0.000	2.193	0.654
6	1999-2006	Deposit Rate	4.365	0.569	0.612	0.889
7	2000-2007	Deposit Rate	5.365	0.126	0.419	0.887
	1992-2007	**Deposit Rate**	20.498	0.000	1.092	0.625
1	1994-2001	Lending Rate	15.499	0.000	2.259	0.354
2	1995-2002	Lending Rate	10.108	0.000	0.013	0.890
3	1996-2003	Lending Rate	6.592	0.000	4.859	0.120
4	1997-2004	Lending Rate	8.299	0.000	7.114	0.045
5	1998-2005	Lending Rate	9.413	0.000	1.386	0.892
6	1999-2006	Lending Rate	10.139	0.000	0.982	0.945
7	2000-2007	Lending Rate	10.612	0.000	0.013	0.954
	1992-2007	**Lending Rate**	10.921	0.000	4.859	0.136

Table F3

Conc. Rank			SR		LR	
	NIGERIA		*F-stat*	*Prob.*	*F-stat*	*Prob.*
1	1994-2001	Deposit Rate	19.374	0.000	5.696	0.112
2	1995-2002	Deposit Rate	12.635	0.000	10.833	0.000
3	1996-2003	Deposit Rate	8.240	0.000	3.176	0.124
4	1997-2004	Deposit Rate	10.374	0.000	1.818	0.123
5	1998-2005	Deposit Rate	11.766	0.000	0.606	0.137
6	1999-2006	Deposit Rate	12.673	0.009	2.188	0.167
7	2000-2007	Deposit Rate	13.265	0.001	3.219	0.366
	1992-2007	**Deposit Rate**	13.651	0.000	3.892	0.357
1	1994-2001	Lending Rate	7.365	0.000	0.540	0.156
2	1995-2002	Lending Rate	4.256	0.356	2.813	0.366
3	1996-2003	Lending Rate	3.257	0.257	7.660	0.046
4	1997-2004	Lending Rate	4.366	0.660	9.916	0.037
5	1998-2005	Lending Rate	4.365	0.366	4.186	0.669
6	1999-2006	Lending Rate	4.365	0.146	1.817	0.369
7	2000-2007	Lending Rate	16.582	0.008	2.813	0.156
	1992-2007	**Lending Rate**	15.567	0.007	7.660	0.000

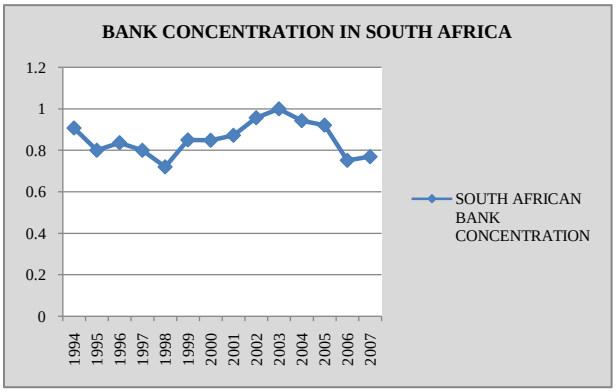
Table F4						
Conc. Rank			**SR**		**LR**	
	ZAMBIA		*F-stat*	*Prob.*	*F-stat*	*Prob.*
1	1994-2001	Deposit Rate	16.878	0.000	1.475	0.924
2	1995-2002	Deposit Rate	22.015	0.000	1.737	0.845
3	1996-2003	Deposit Rate	14.358	0.000	4.548	0.365
4	1997-2004	Deposit Rate	9.364	0.000	8.215	0.065
5	1998-2005	Deposit Rate	11.788	0.000	12.998	0.036
6	1999-2006	Deposit Rate	13.370	0.006	6.165	0.089
7	2000-2007	Deposit Rate	14.401	0.000	4.383	0.126
	1992-2007	**Deposit Rate**	15.074	0.000	7.999	0.047
1	1994-2001	Lending Rate	10.642	0.045	0.799	0.924
2	1995-2002	Lending Rate	8.369	0.000	1.913	0.854
3	1996-2003	Lending Rate	18.842	0.000	2.639	0.755
4	1997-2004	Lending Rate	21.098	0.000	3.112	0.652
5	1998-2005	Lending Rate	15.368	0.000	3.421	0.685
6	1999-2006	Lending Rate	9.365	0.000	7.500	0.027
7	2000-2007	Lending Rate	7.365	0.000	11.250	0.012
	1992-2007	**Lending Rate**	18.596	0.041	8.365	0.024

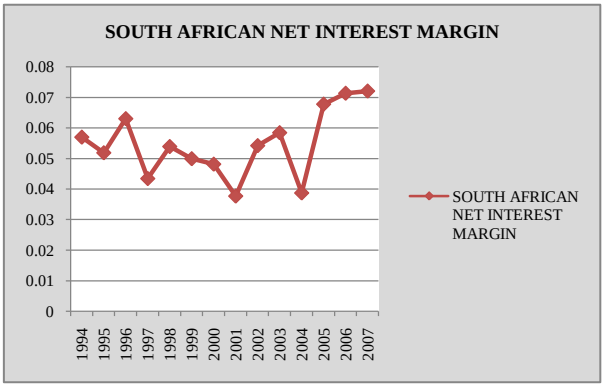
SECTION G: ROLLING WINDOW CONCENTRATION LEVELS

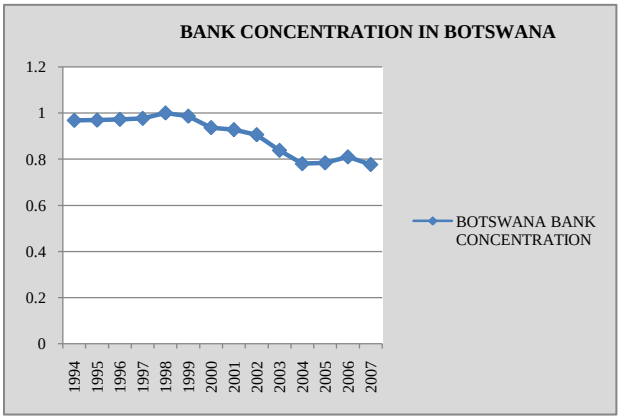
		RSA		BOTSWANA		NIGERIA		ZAMBIA	
Table H1	**CR3**								
	Period	**Conc. Level**	**Conc. Rank**	**Conc. Level**	**Conc. Rank**	**Conc. Level**	**Conc. Rank**	**Conc. Level**	**Conc. Rank**
	1994-2001	0.82997	**7**	0.96702	**1**	0.49582	**1**	0.74408	**1**
	1995-2002	0.83617	**6**	0.95926	**2**	0.44532	**2**	0.70881	**2**
	1996-2003	0.86107	**5**	0.94289	**3**	0.41283	**3**	0.68047	**3**
	1997-2004	0.87434	**4**	0.91888	**4**	0.40161	**4**	0.65875	**4**
	1998-2005	0.88949	**2**	0.89482	**5**	0.40032	**5**	0.62463	**5**
	1999-2006	0.89341	**1**	0.87105	**6**	0.40248	**6**	0.61076	**6**
	2000-2007	0.88331	**3**	0.84487	**7**	0.40133	**7**	0.59941	**7**

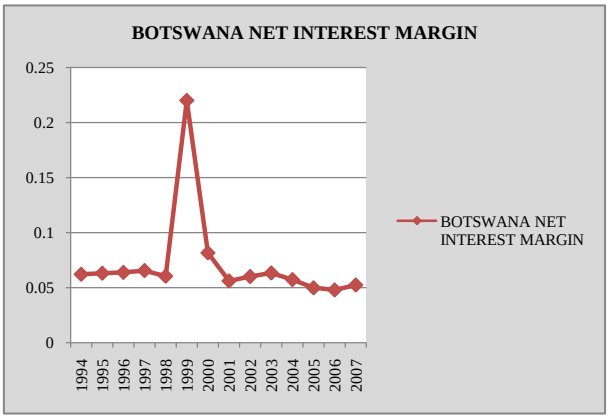
SECTION H: BANK CONCENTRATION AND NET INTEREST MARGIN

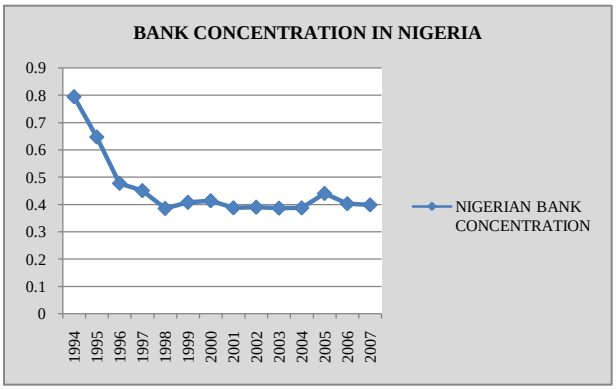
Adapted from a New Database on Financial Development Structure 2007 (World Bank, 2009).

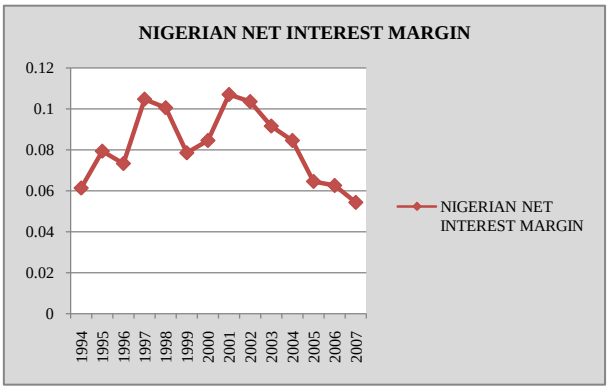


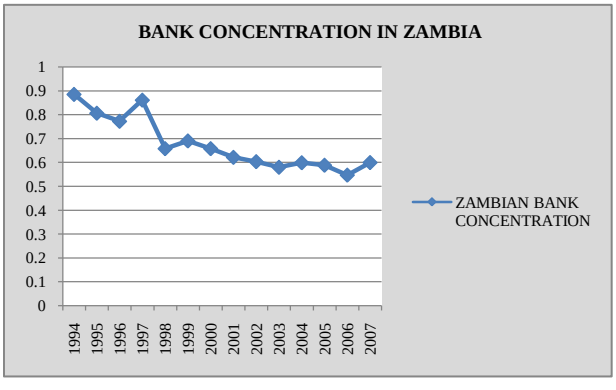


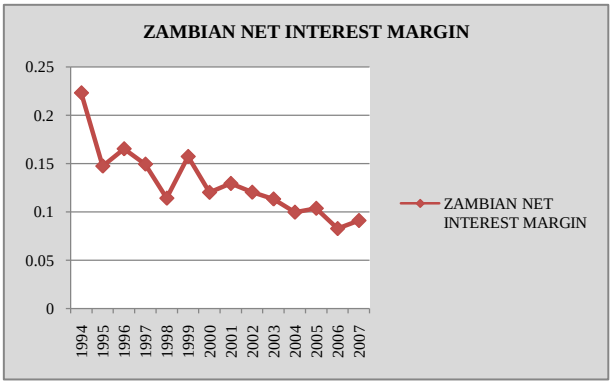




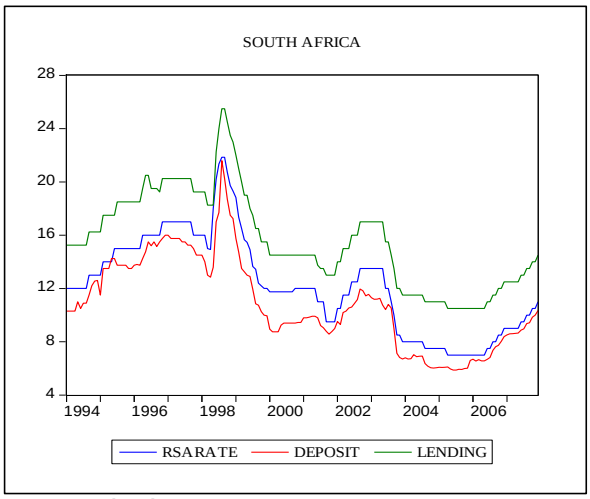




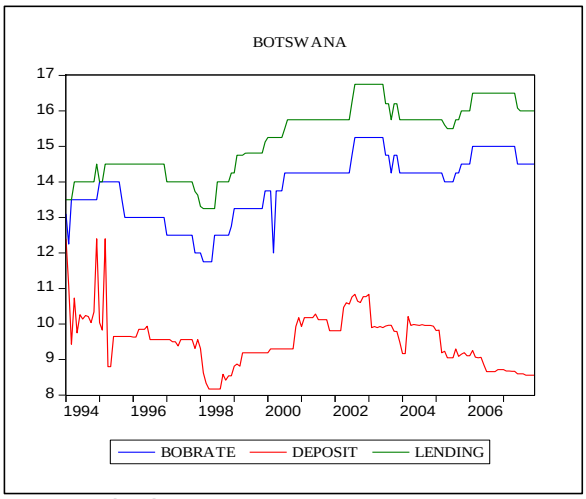




SECTION I: THE TREND OF POLICY, LENDING AND DEPOSIT RATES



RSARATE is the policy rate



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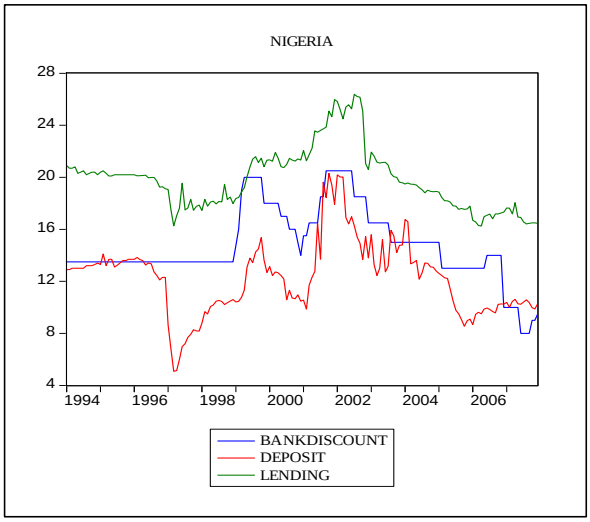
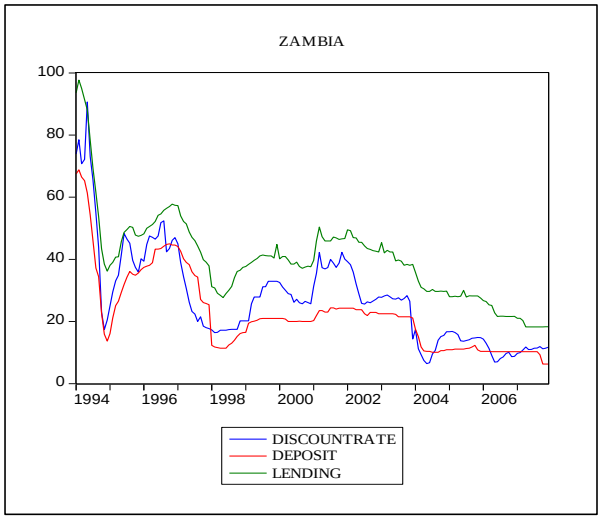


BANKDISCOUNT is the policy rate



DISCOUNTRATE is the policy rate